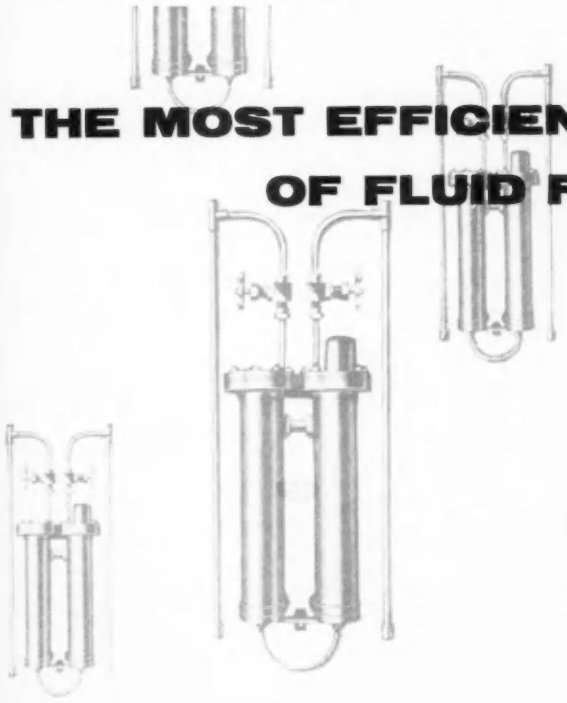
ENGINEERING AND
BOILER HOUSE REVIEW
ESTABLISHED 1899
TWO SHILLINGS & SIXPENCE

VOL. 74 NO. 12 • THE PIONEER STEAM JOURNAL • DECEMBER, 1959

Electroflo
Meters & Controls

THE MOST EFFICIENT MEANS OF FLUID FLOW MEASUREMENT



1 One operating principle — one general construction mode — for all fluids and gases under all conditions of measurement. Minimum service requirement.

2 Standardised, independent and interchangeable reading instruments — located at any distance from actual measuring point: separated grouped or duplicated to meet any operating or supervisory requirement.

3 Linear scales. Square root extraction effected by parabolic contour of resistance element.

4 Full 4" mercury rise.

5 Unrestricted mercury column gives maximum sensitivity to flow rate changes. Accurate to within ±0.5%. Differential pressure change modifies circuit resistance. Conductance proportional to flow rate: easily checked in situ by substitution of standard resistance.

6 A.C. mains operation: unaffected by supply voltage and frequency variations.

7 NO CASTINGS. — Interchangeable tubular manometer with drop-forged ends. Readily available for any specified line pressure. No glands: integral equalising valve: over-range protection and dirt traps

8 High-speed, frictionless integration. Integration is totalising conductance meter measuring amperes x time/volts.

9 Wide choice of interpretive instruments — see illustrations.

10 Equipped for data reduction: control circuits and available for long distance transmission. Also accepts 3-15 p.s.i. pneumatic signal. Further particulars on application

'Miniature' instruments for graphic consoles and comprehensive supervisory panels.

Model No. 365 6"x 6" rate of flow indicator

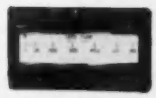
Model No. 259 6"x 6" high-speed integrator

Model No. 199 4", 1000-hour strip chart recorder

Model No. 355 12" diam. rate-of-flow indicator

Model No. 350 multi-point, 12" continuous roll chart recorder

Model No. 224 12" diam. recorder: 10½" diameter linear chart



Model No. 223 10" scale edgewise type rate-of-flow indicator

TENS OF THOUSANDS IN OPERATION IN EVERY CLASS OF INDUSTRY THROUGHOUT THE WORLD. FOR FURTHER PARTICULARS, ASK PUBLICATIONS DEPARTMENT FOR CATALOGUE No. 65

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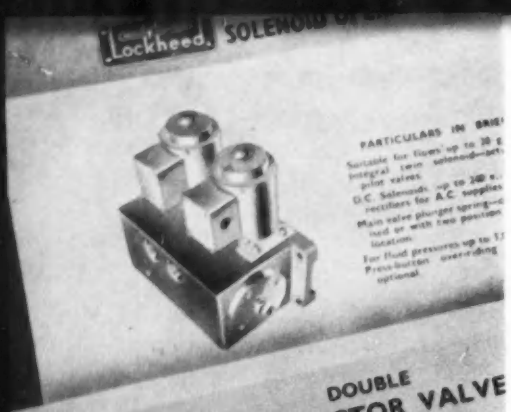

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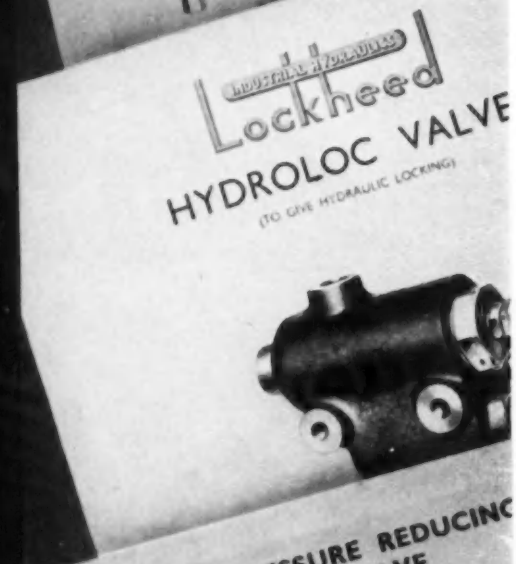

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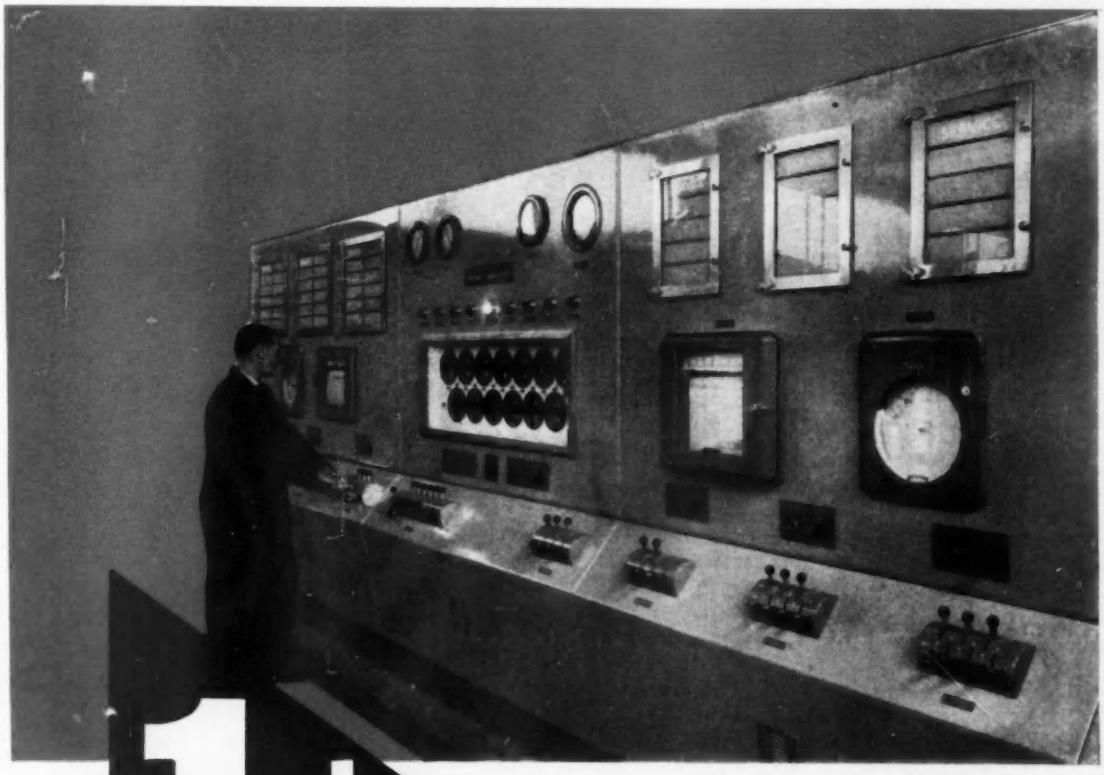

1st

FULLY AUTOMATIC MIXED BED PLANT IN GREAT BRITAIN

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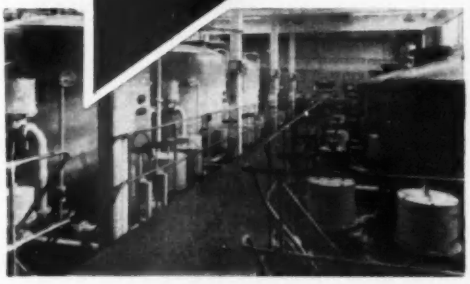

This plant demonstrates once again Permutit's leadership in the design of water treatment plant. For boiler feed, Mixed Bed "Deminrolit" plant provides water of exceptional purity (conductivity 0.2 micromhos per cm.).

"Deminrolit" plant is but one of a complete range of Permutit water treatment plants designed to provide perfect feed water for boilers of all types and pressures.

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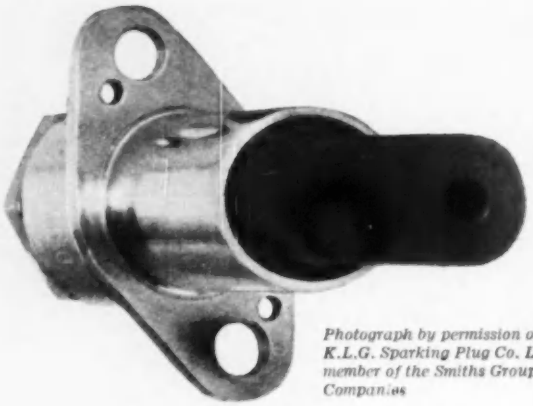


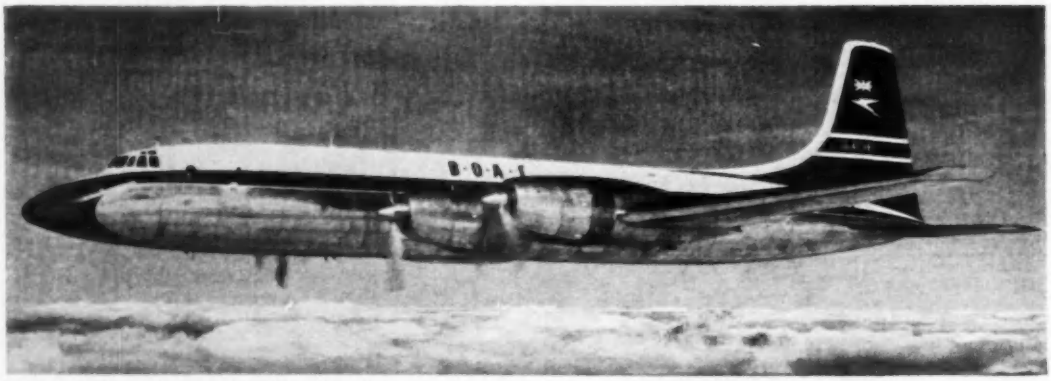
Photograph by permission of the K.L.G. Sparking Plug Co. Ltd, a member of the Smiths Group of Companies

REFRAX refractory
Regd
for the jet age

For economy, jet and turbo-prop planes fly high, where temperatures may be 40° below zero. An interruption in the continuous process of combustion can result in a "flame-out", presenting the problem of re-lighting the fire in the sub-zero hurricane that blows through the combustion chambers. Various devices have been invented to counteract "flame-out", but the simplest is the "Glow Plug"—a device developed in collaboration with Smiths and Bristol Siddeley Engines Ltd—which re-ignites the fuel in even the most rigorous conditions.

The re-ignition problem was solved initially by the use of platinum alloy, but REFRAX refractory material has replaced this, not only at a fraction of the cost but also giving several times the life.

The manufacture of refractory material to fine-dimension limits—as specified by the aircraft industry—at reasonable cost and in large quantities is exceedingly difficult. But CARBORUNDUM have achieved just this, with their REFRAX Nitride-bonded Silicon Carbide.



Photograph by courtesy of Bristol Aircraft Limited

Products by CARBORUNDUM TRADE MARK can cut your costs

We are indeed proud that Bristol Siddeley Engines Ltd have accepted REFRAX refractory as standard material for the "Glow Plug" safety device in the Proteus engine, powering the Bristol Britannia airliner. We should be pleased to solve your own particular refractory problem.

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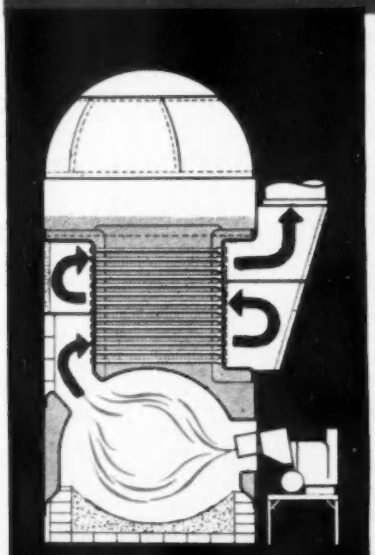
2A

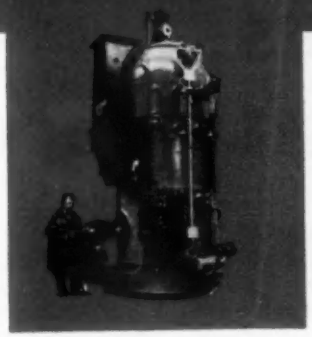
the VERTICAL Vogue



This neat and well established vertical profile gives assurance of complete satisfaction. Reliability coupled with the latest devices giving completely automatic control and a highly efficient performance meets every requirement.

The vital statistics of Series II will interest you, for instance a guaranteed efficiency of over 80% on the gross calorific value of the fuel, fully automatic controls, oil-fired yet convertible to solid fuel, having generous steam space, being fully tested and set before despatch.

All this without sacrificing the essential design features of Cochran Vertical Boilers which have, over the years, shown supreme qualities of reliability and durability. Vertical Boilers require the minimum of space.



Series II boilers are available in ratings from 1,750 to 10,000 lbs. per hour from and at 212°F.

A Series II under test. Special lagging covered with steel sheeting, banded in position, completes the finish at site.

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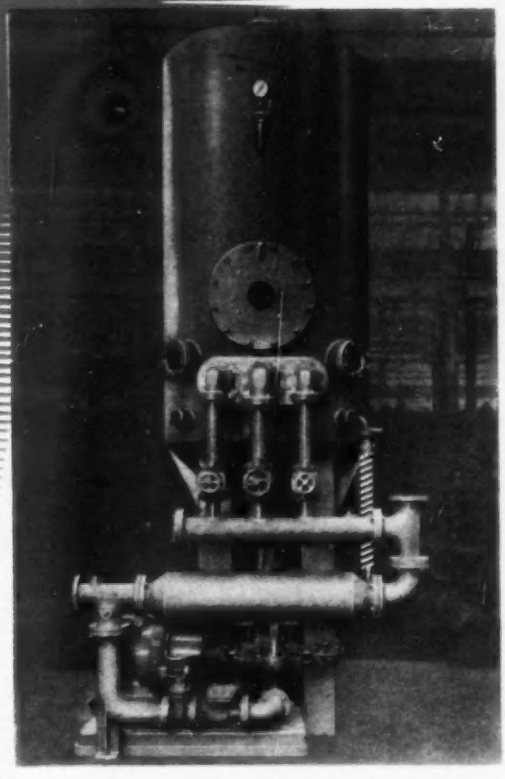

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The recirculating deaerator developed by Hick Hargreaves provides a simple and dependable means of preventing corrosion by reducing the oxygen content of the feed water. Effective deaeration is assured under all conditions of flow, no matter how wide or rapid the fluctuations in the feed rate, whilst the absence of floats and spray valves ensures great reliability. Three types are available. The Straight Spray Type is suitable for handling feed water from 130°F (55°C) to 200°F (95°C) and requires no heating steam for its operation. The Direct Contact Heating Deaerator accomplishes the dual purpose of deaerating and heating cold water up to a maximum outlet temperature of 180°F (82°C).

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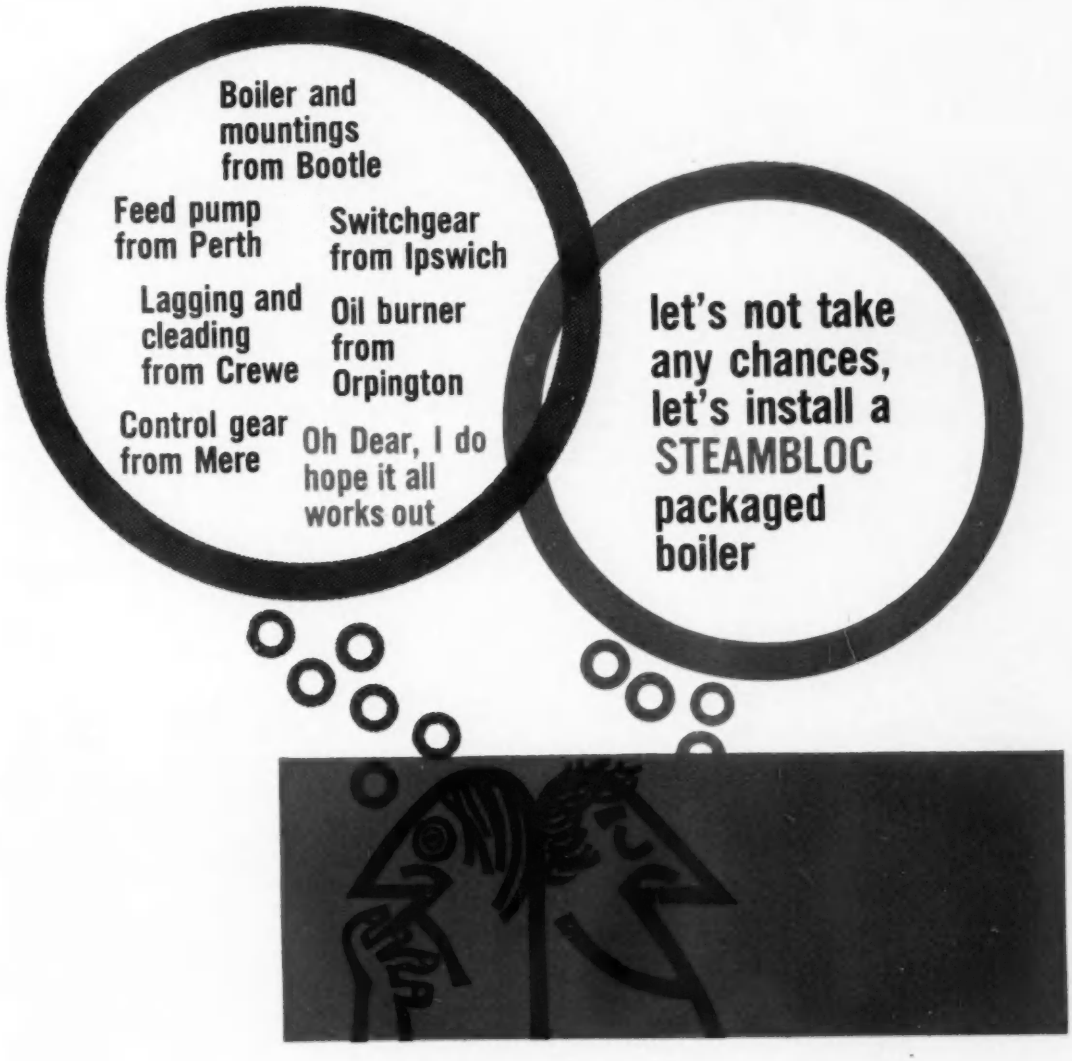
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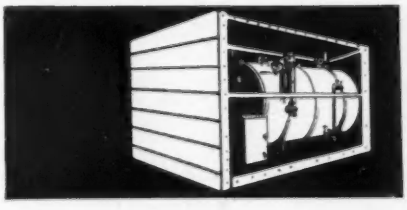

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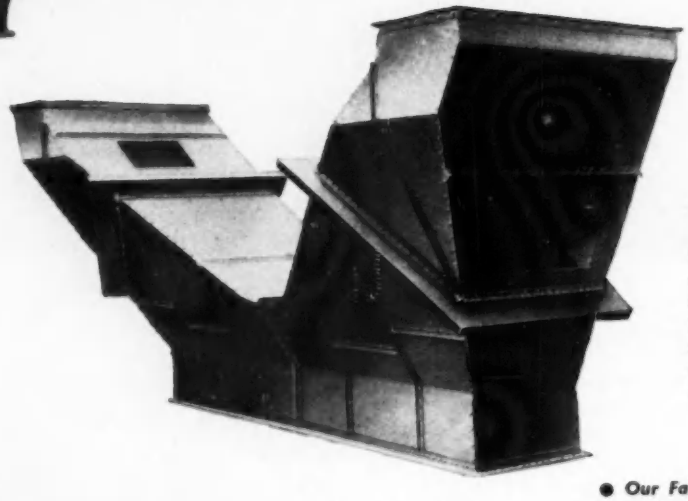

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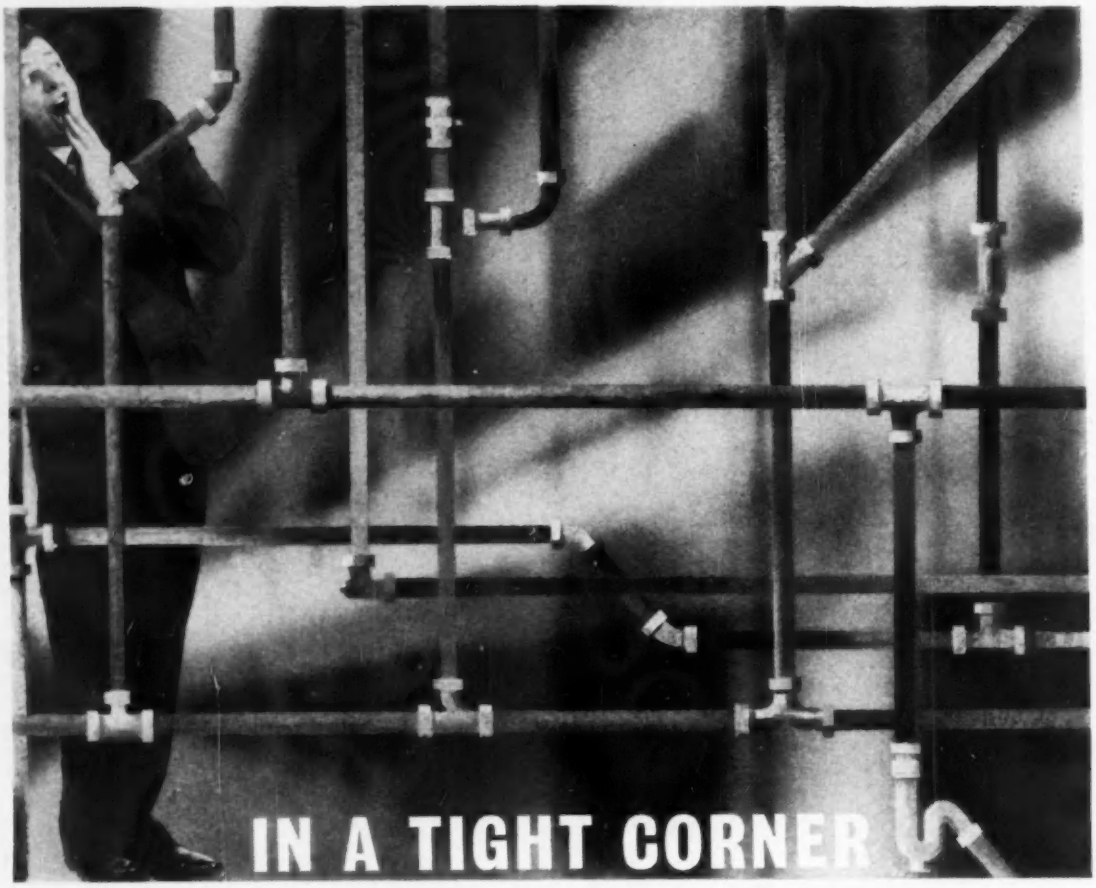

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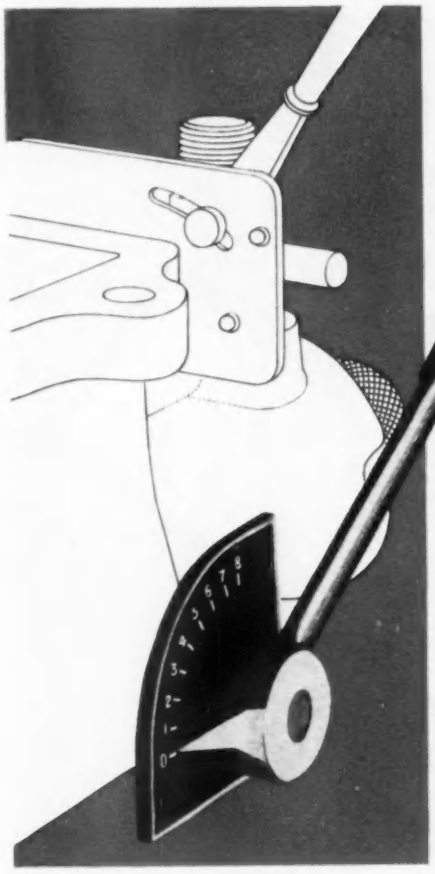

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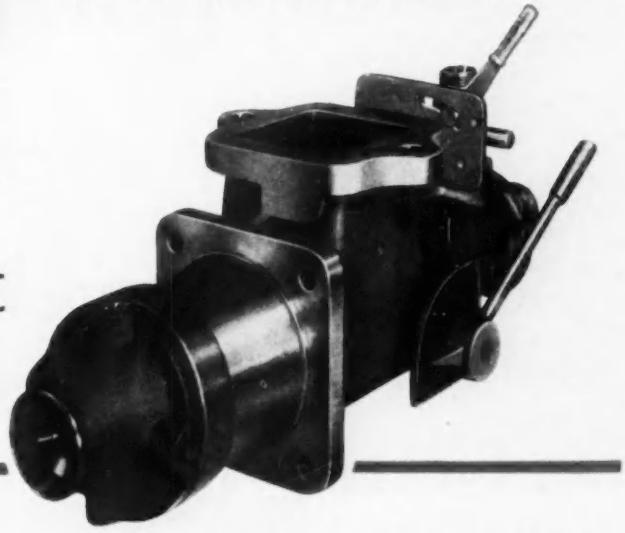

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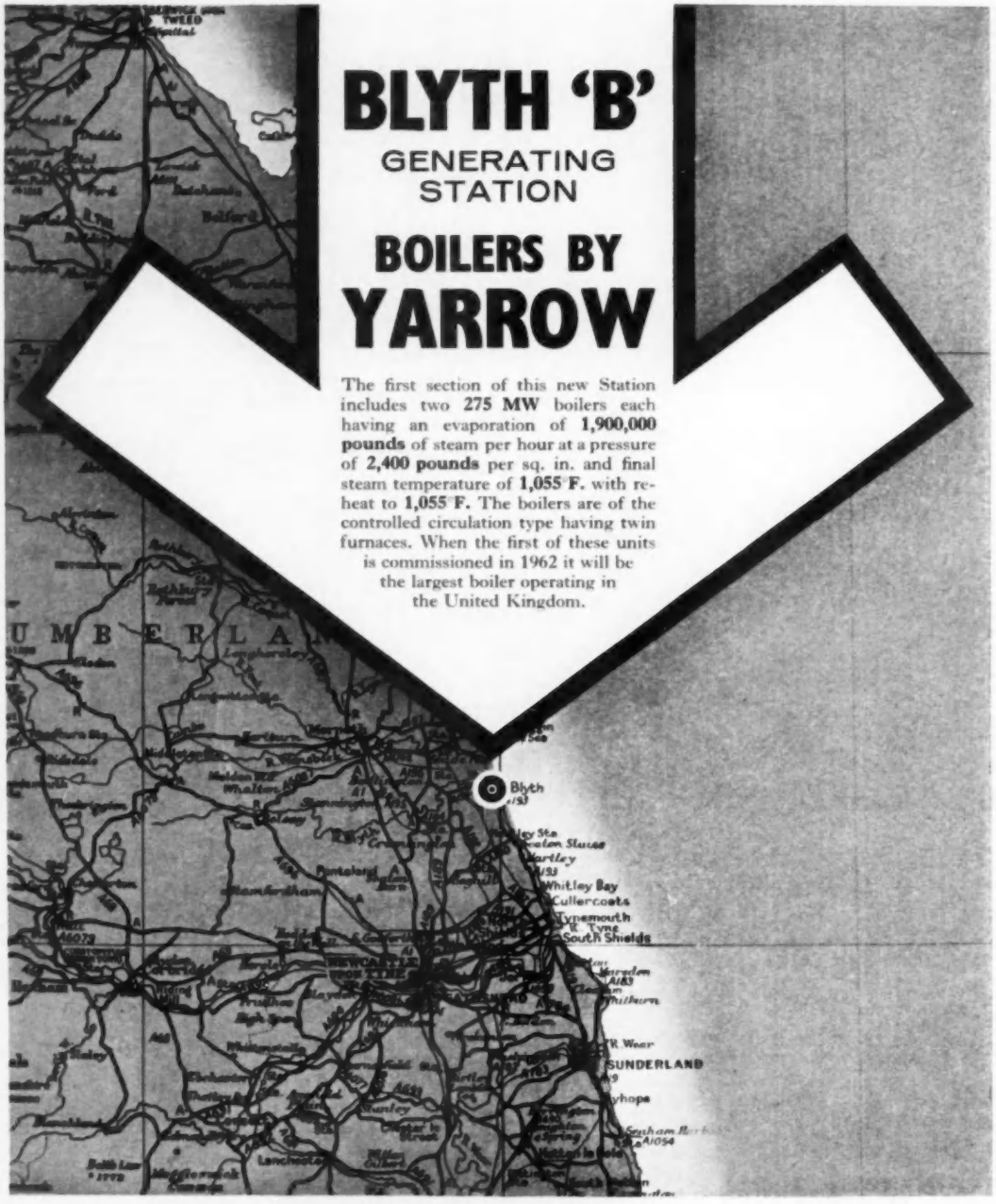

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GENERATING STATION

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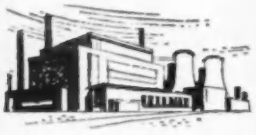


HINKLEY
C.E.G.B. NUCLEAR POWER STATION

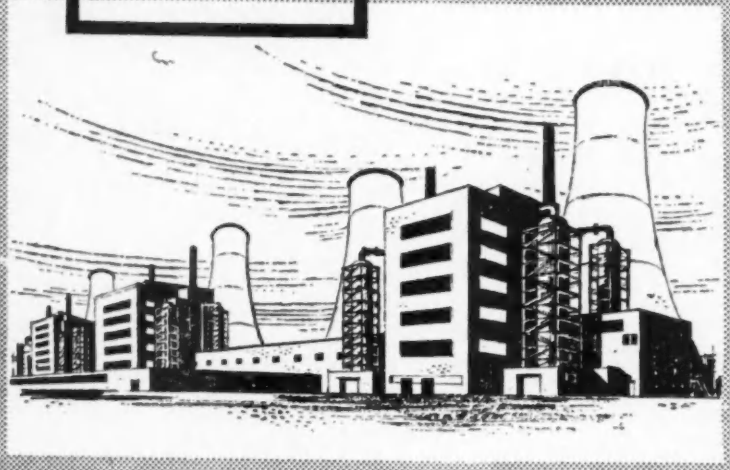
At Hinkley Point Newalls have been entrusted with the insulation of the reactors steam raising units, gas ducting integral piping etc., under contract to Babcock and Wilcox Ltd

CHAPELCROSS
U.K.A.E.A. NUCLEAR POWER STATION

Under contract to Babcock and Wilcox Ltd., Newalls are carrying out the insulation of the 16 steam raising units and integral piping. The insulation of turbines, blowers, associated auxiliary equipment and piping is being carried out under contract to C. A. Parsons and Co. Ltd.

BRADWELL
C.E.G.B. NUCLEAR POWER STATION

At Bradwell-on-Sea a further large contract for the thermal insulation of turbines, associated auxiliary equipment and piping (main and auxiliary turbine plants) has also been placed by C. A. Parsons and Co. Ltd with Newalls.



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Howden are supplying two forced-draught fans, two induced-draught fans and one recirculating fan

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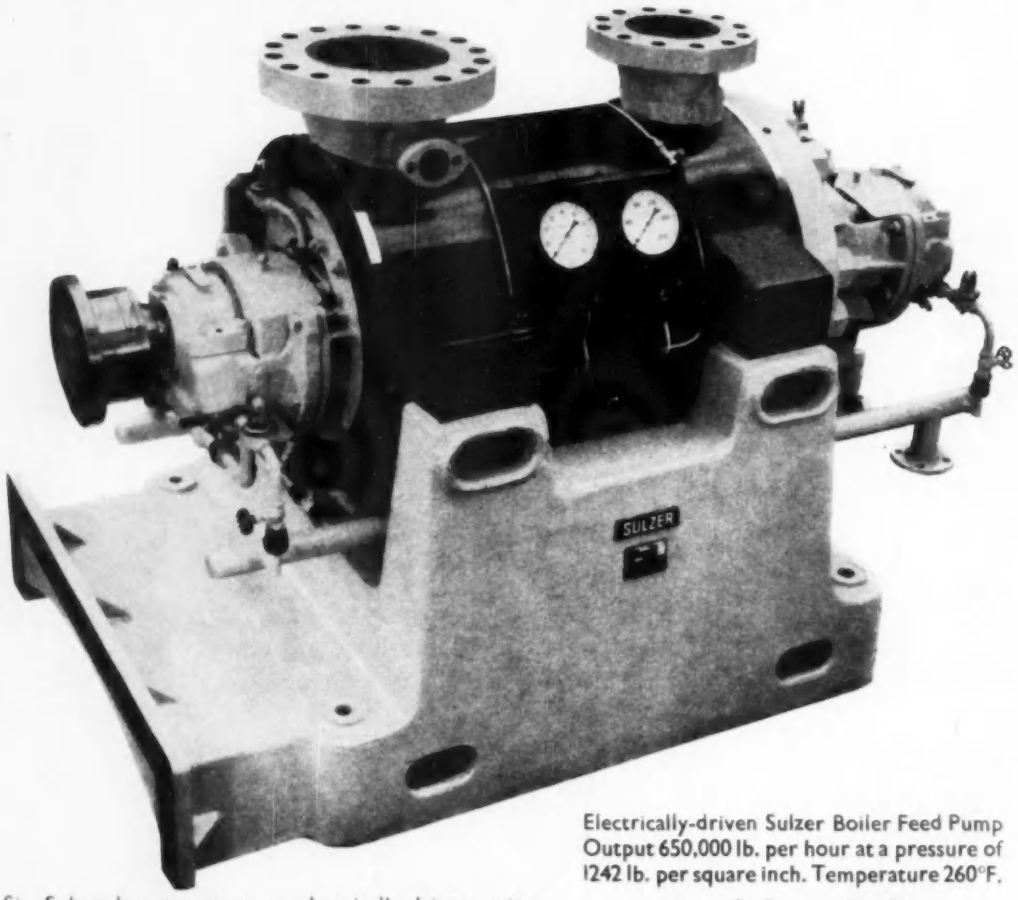
SULZER
BOILER - FEED PUMPS



Six Sulzer low temperature electrically-driven units each rated for an output of 650,000 lb./hr. have been supplied for the **CHAPELCROSS** installation of the **UNITED KINGDOM ATOMIC ENERGY AUTHORITY**

Electrically-driven Sulzer Boiler Feed Pump Output 650,000 lb. per hour at a pressure of 1242 lb. per square inch. Temperature 260°F.

one of nine units for MARCHWOOD POWER STATION *of the* **CENTRAL ELECTRICITY GENERATING BOARD**

Complete range of Boiler Feed Pumps for nuclear and orthodox thermal plants including advanced class units.

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We will advise you.
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Pressures to 600-800 psi.
Diameter to 6' 6".

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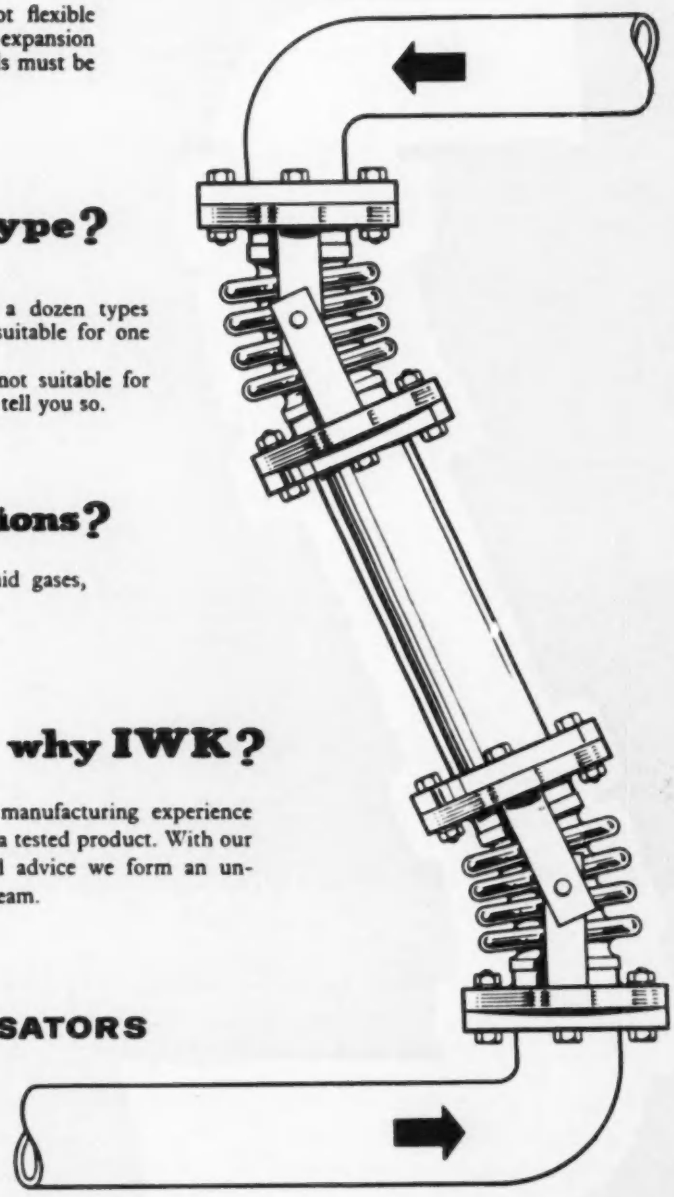
60 years' manufacturing experience gives you a tested product. With our specialized advice we form an unbeatable team.



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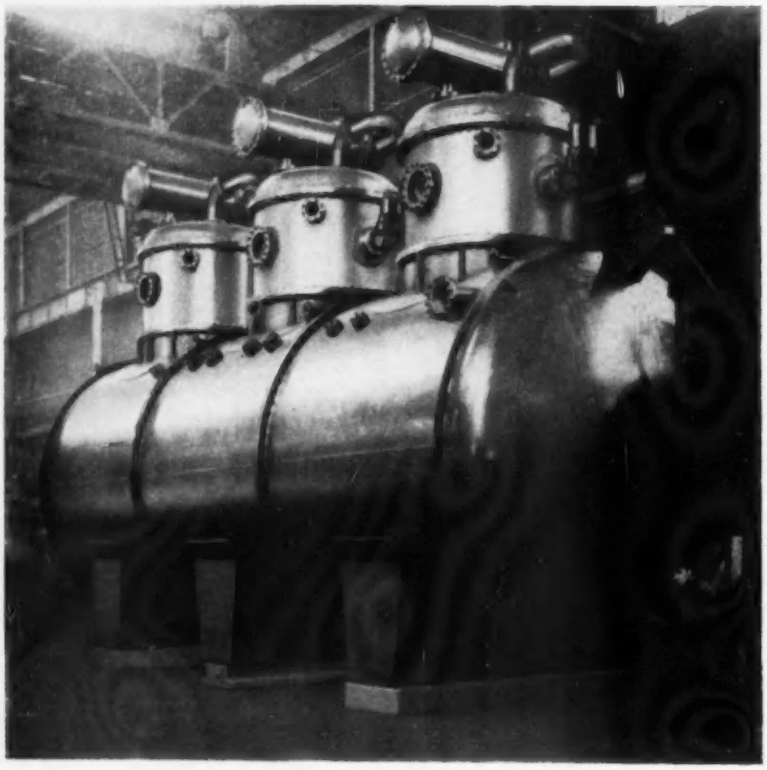
Weir DE-AERATORS

eliminate oxygen corrosion in the power plant



Prolong life of boiler tubes, economisers, valves and other surfaces.

Heat in operating steam retained in feed-water.

The Weir triple De-aerators illustrated are mounted on a feed tank 35 ft. long, 12 ft. 6 in. diameter, and have a normal output of 1,300,000 lb./hr. at 280° F.

We invite enquiries for the most suitable equipment to meet specified requirements.

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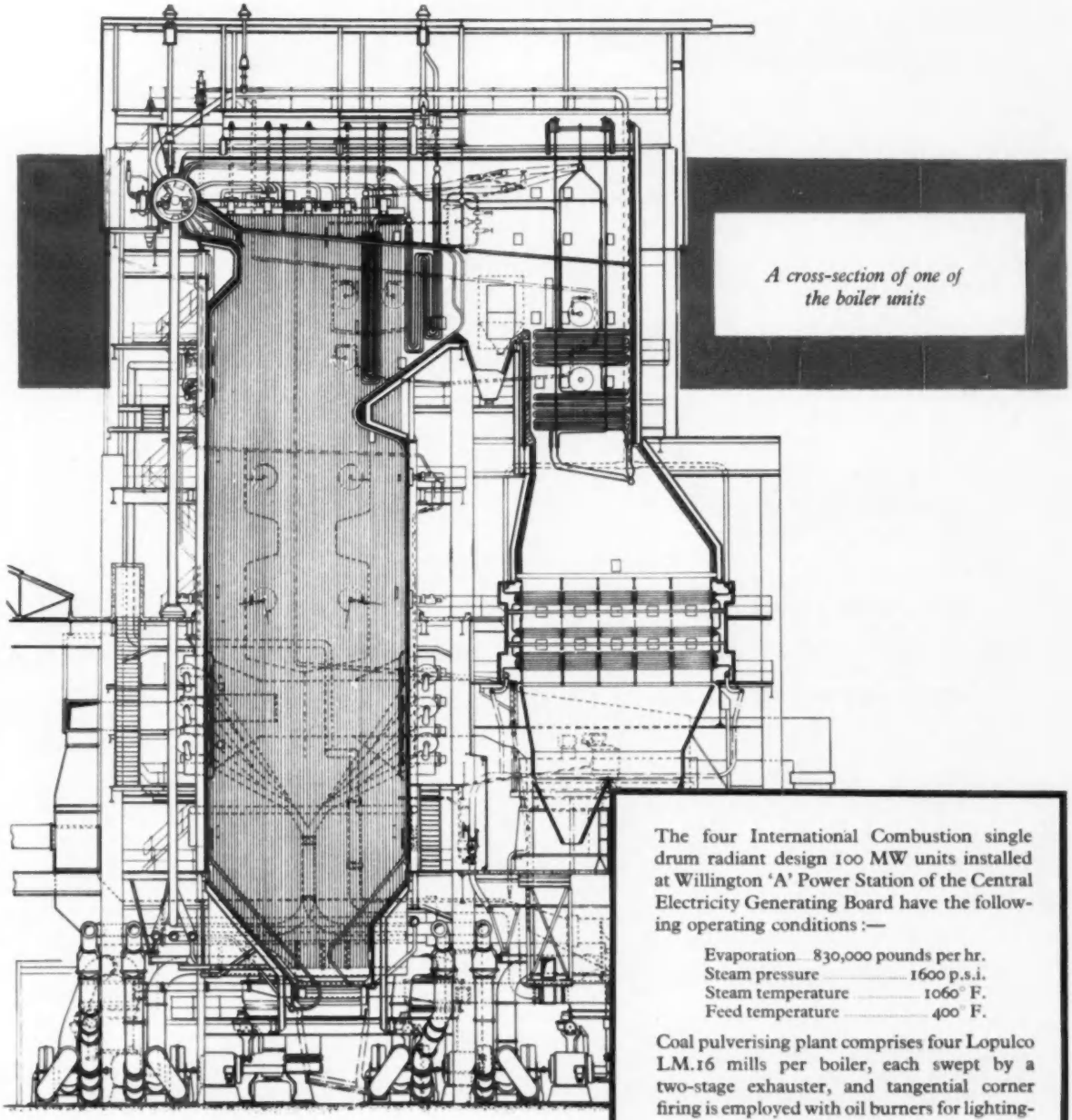
The semi-outdoor design IC boiler plant

AT WILLINGTON 'A' POWER STATION



A cross-section of one of the boiler units

The four International Combustion single drum radiant design 100 MW units installed at Willington 'A' Power Station of the Central Electricity Generating Board have the following operating conditions :—

Evaporation	830,000 pounds per hr.
Steam pressure	1600 p.s.i.
Steam temperature	1060° F.
Feed temperature	400° F.

Coal pulverising plant comprises four Lopulco LM.16 mills per boiler, each swept by a two-stage exhauster, and tangential corner firing is employed with oil burners for lighting-up and to carry light loads.

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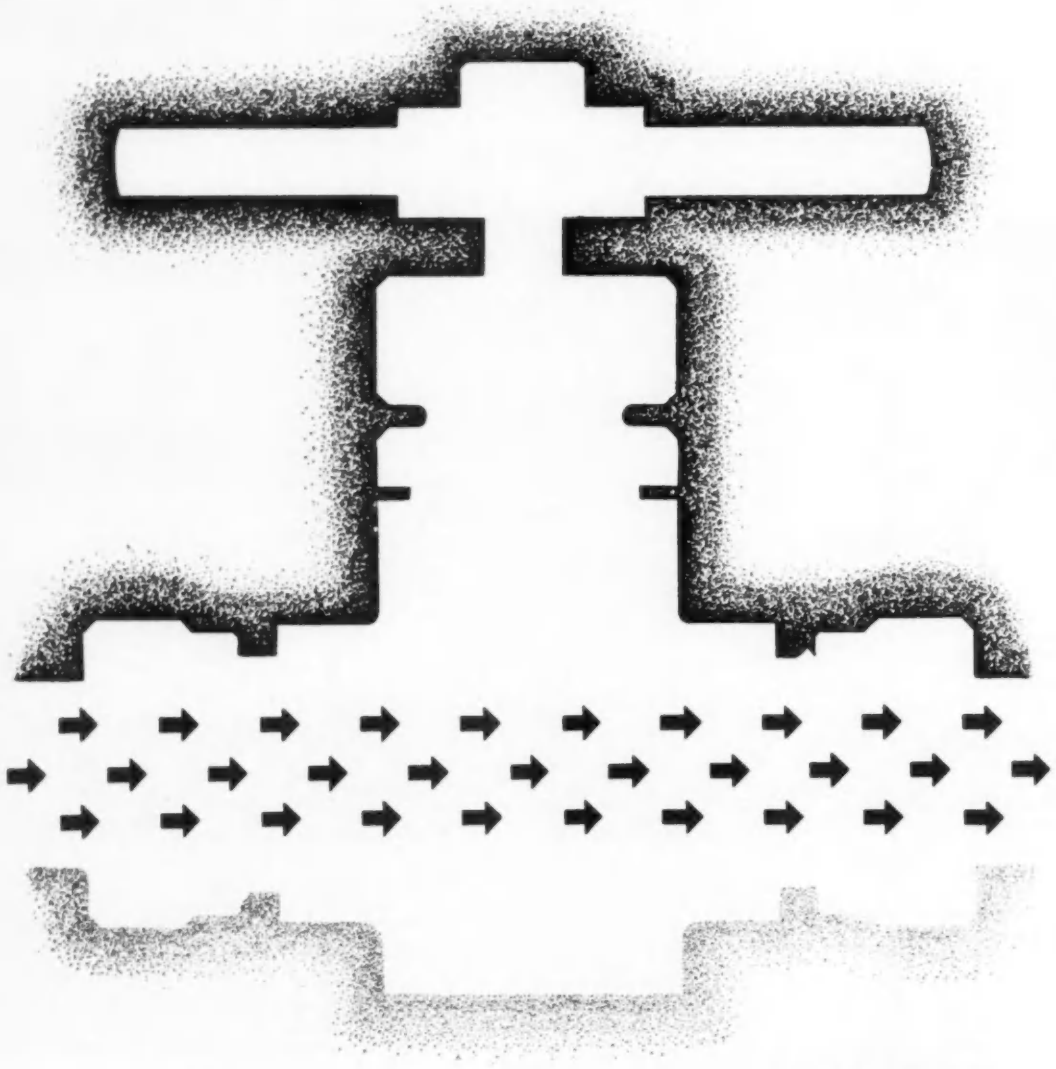
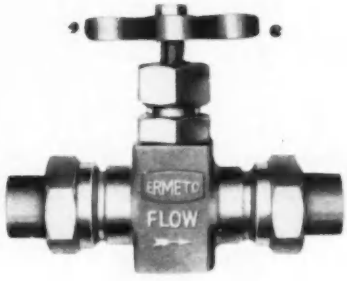


in connection with high pressure

ERMETO VALVES, incorporating the famous **ERMETO** High Pressure Couplings are designed for use with a wide range of fluids, and are tested to one and a half times the recommended working pressure. They are available with standard Ermeto end connections. Non-standard valves can be made by special arrangement. Technical advice and fully illustrated catalogue will be supplied on request.



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With a static or even declining labour force, our production can increase only by making more use of the techniques, plant and men we already have.

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Being automatic, they release human hands for more productive work while giving *at least* as reliable a service.

By maintaining temperatures in a sensible relationship with the conditions, they save fuel and ensure greater, more predictable, quality in the product.

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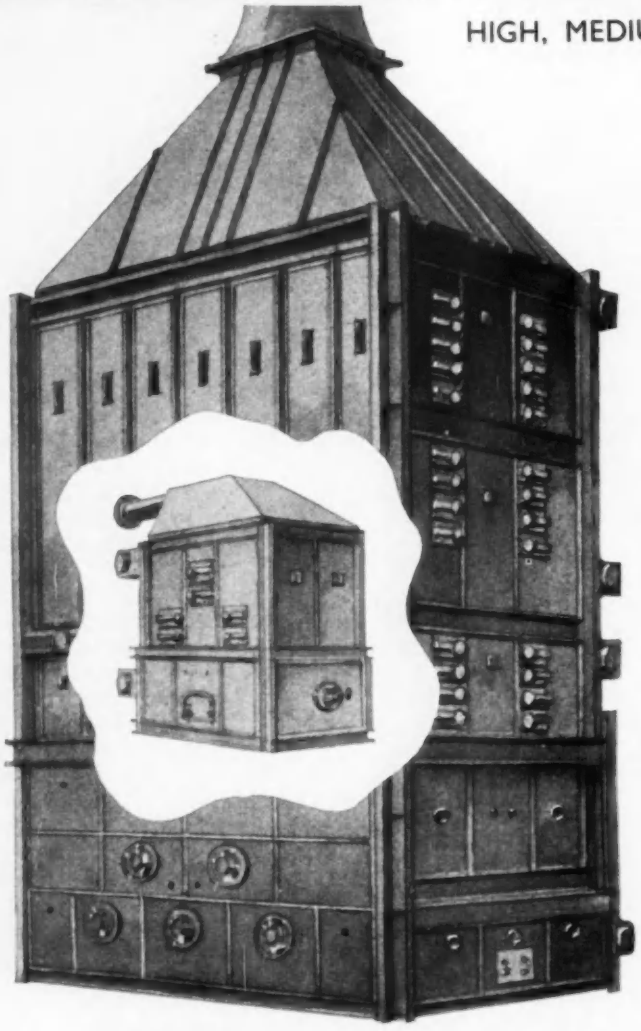
HIGH, MEDIUM and LOW PRESSURES



LA MONT Hot Water Boilers are installed for a wide range of capacities and conditions. Illustration shows comparative size of oil-fired boiler for capacity of 70,000,000 Btu./Hr. with 2,000,000 Btu. boiler inset to the same scale.

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CLEAN AIR ACT

As recently announced in the press, a new ministerial order permits the installation of mechanical coal burning equipment in Smoke Control Areas. It follows that the most modern and efficient plant should, of course, be installed on the lines of the latest Hodgkinson boiler house equipment.

"METERFEED" UNDERFEED STOKER

This stoker has separate drive and fan motors which our "Custodian" Panel controls by cutting in the fan at a predetermined period before the drive and cutting out the fan after the drive has stopped.
The "Meterfeed" Underfeed Stoker is designed for the utmost fuel economy **without smoke** and is available in a full range of sizes in both hopper and bunker feed models and suitable for boiler, kiln and furnace application. All models embody the controlled feed principle.

NEW "CUSTODIAN" CONTROL PANEL

The combination of the "Custodian" panel with the "Meterfeed" Underfeed Stoker operates as a highly efficient guarantee against the production of smoke and its consequences under the Clean Air Act.

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★ *Entirely new concept of simple design*

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★ *Easy assembly in a matter of hours*

★ *Many new features incorporated*

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The elevators in this range are made up from standard parts available from stock.

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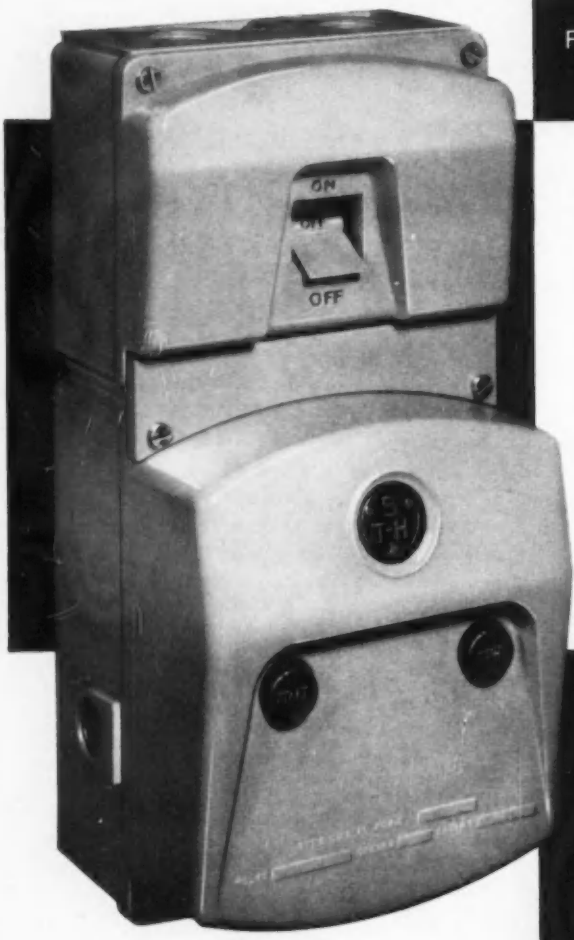
Up to 7½ h.p. 200-550 volts 25-60 cycles

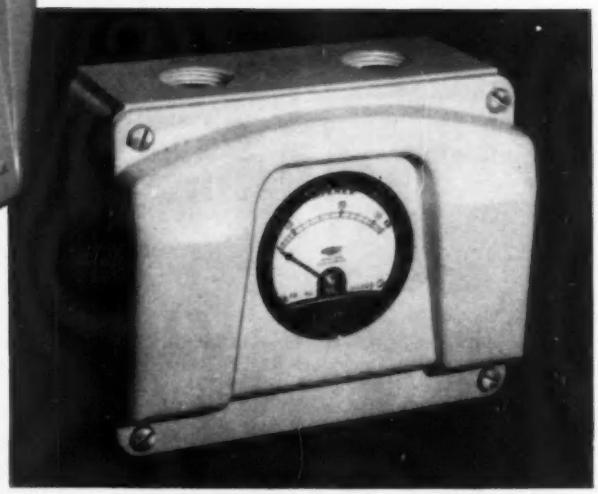
For three-phase or single-phase non-reversing squirrel-cage induction motors.



These well-established contactor switch-starters are now available fitted with mechanically interlocked three- or five-pole isolating switch. An ammeter unit and/or HRC fuse unit can also be accommodated in addition to, or in place of, the isolating switch unit.

The isolating switch can be supplied as a 3-pole 'on-load' switch rated at 30 amperes maximum (tested to break 100 amp. at 440 v.), or alternatively in 5-pole form with three main 30-amp. poles plus two normally open control-circuit auxiliary poles.

The starters comply in every respect with BS587, 1957 for 'Frequent Duty', i.e. forty starts per hour.



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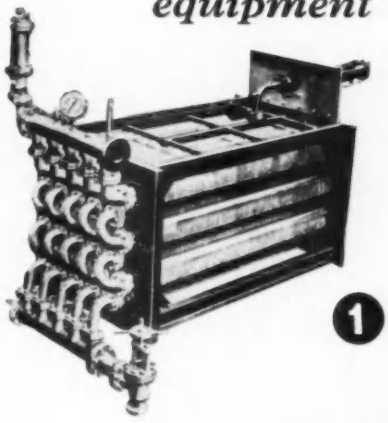
offer a complete range of equipment



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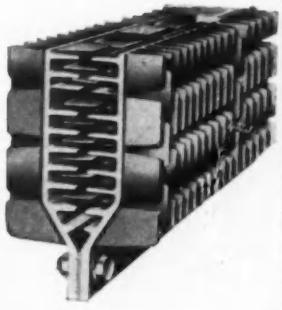

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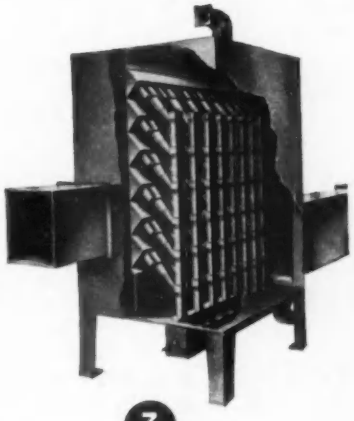

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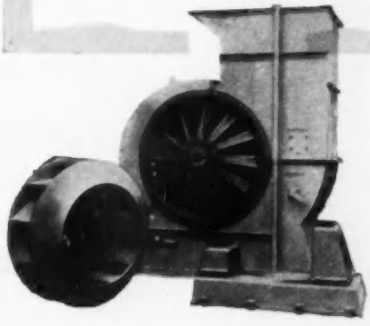

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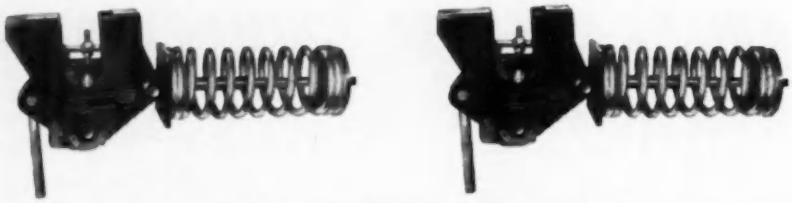
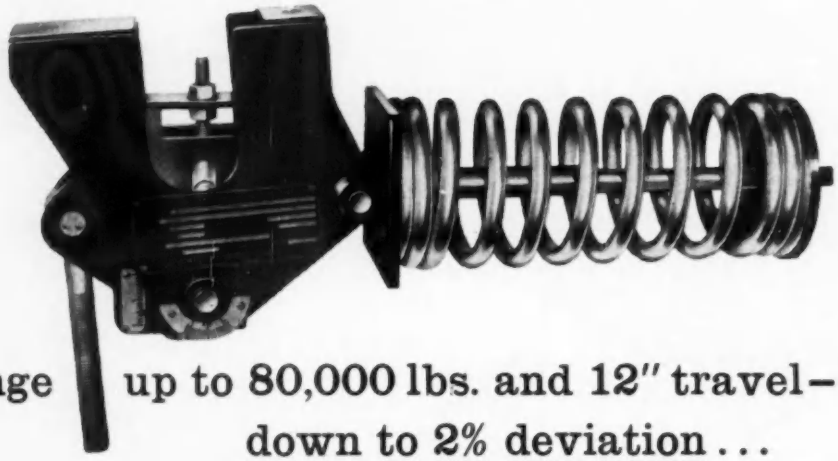


Now... the new 'M' Hanger...



in a range up to 80,000 lbs. and 12" travel–
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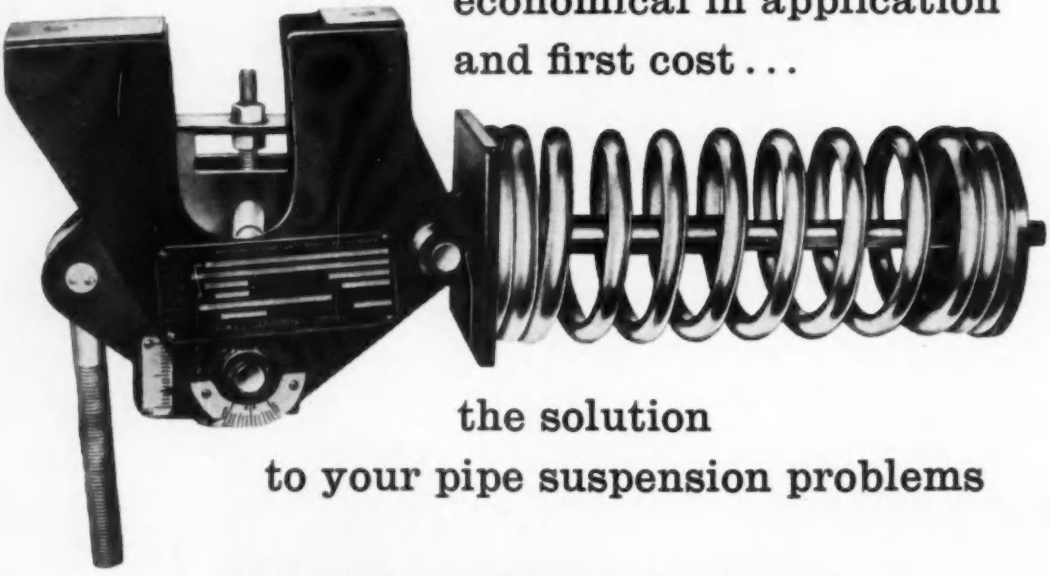
economical in application
and first cost...



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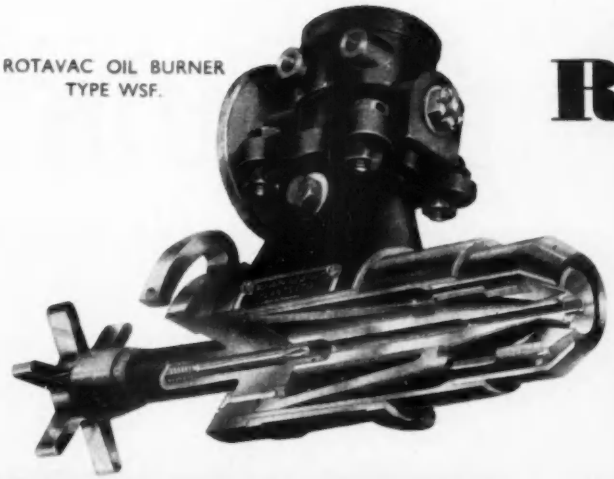

ROTAVAC OIL BURNER
TYPE WSF.

ROTAVAC
–makes boilers give their best

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ROTAVAC oil-firing offers—

UNSURPASSED STEAM OUTPUT per pound of fuel, year in year out, without adjustment.

ONLY ONE MOVING PART—the Fan—and that far from the flame means nothing to repair and little to maintain.

PERFECT COMBUSTION OF ANY LIQUID FUEL including the heaviest, cheapest grades. Rotavac's soft, gaseous flame is kind to brickwork and prolongs fire-box life.

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Write now for performance details and design information to:

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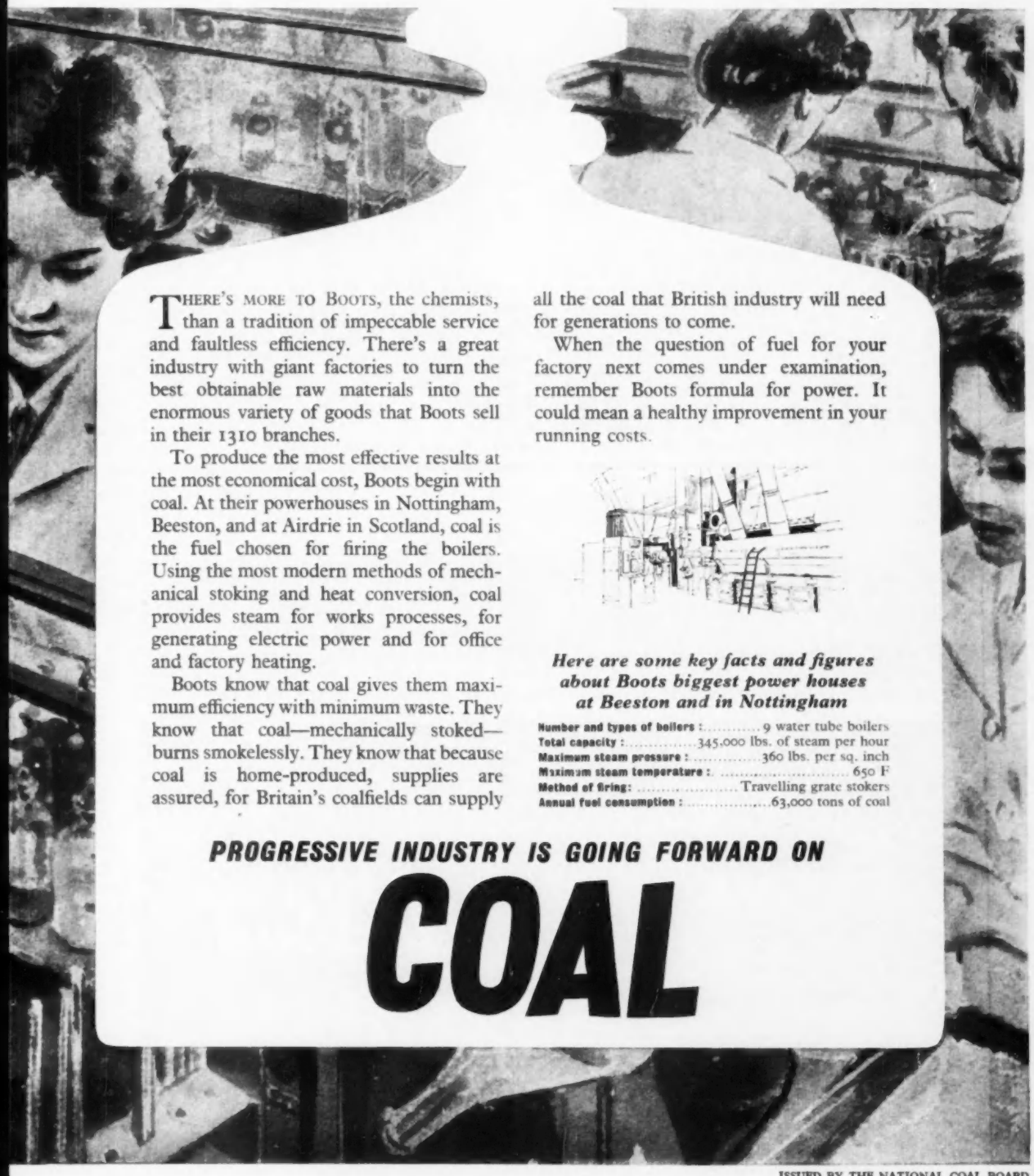
Boots formula

for power – Coal



THERE'S MORE TO BOOTS, the chemists, than a tradition of impeccable service and faultless efficiency. There's a great industry with giant factories to turn the best obtainable raw materials into the enormous variety of goods that Boots sell in their 1310 branches.

To produce the most effective results at the most economical cost, Boots begin with coal. At their powerhouses in Nottingham, Beeston, and at Airdrie in Scotland, coal is the fuel chosen for firing the boilers. Using the most modern methods of mechanical stoking and heat conversion, coal provides steam for works processes, for generating electric power and for office and factory heating.

Boots know that coal gives them maximum efficiency with minimum waste. They know that coal—mechanically stoked—burns smokelessly. They know that because coal is home-produced, supplies are assured, for Britain's coalfields can supply all the coal that British industry will need for generations to come.

When the question of fuel for your factory next comes under examination, remember Boots formula for power. It could mean a healthy improvement in your running costs.

Here are some key facts and figures about Boots biggest power houses at Beeston and in Nottingham

Number and types of boilers :	9 water tube boilers
Total capacity :	345,000 lbs. of steam per hour
Maximum steam pressure :	360 lbs. per sq. inch
Maximum steam temperature :	650 F
Method of firing:	Travelling grate stokers
Annual fuel consumption :	63,000 tons of coal

PROGRESSIVE INDUSTRY IS GOING FORWARD ON

COAL

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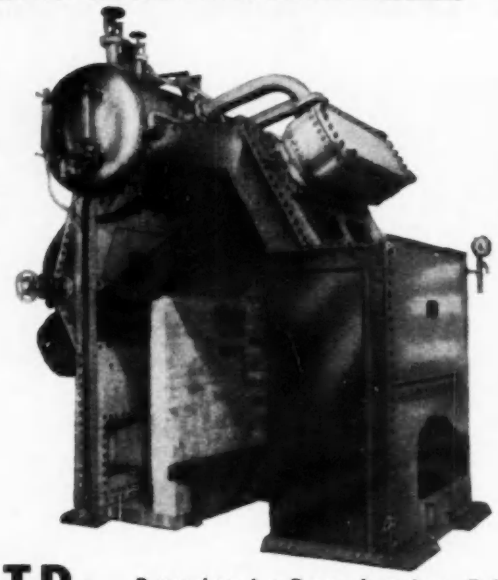
When Replacing Obsolete STEAM BOILERS

INSTAL THE FRASER WATER-TUBE BOILER



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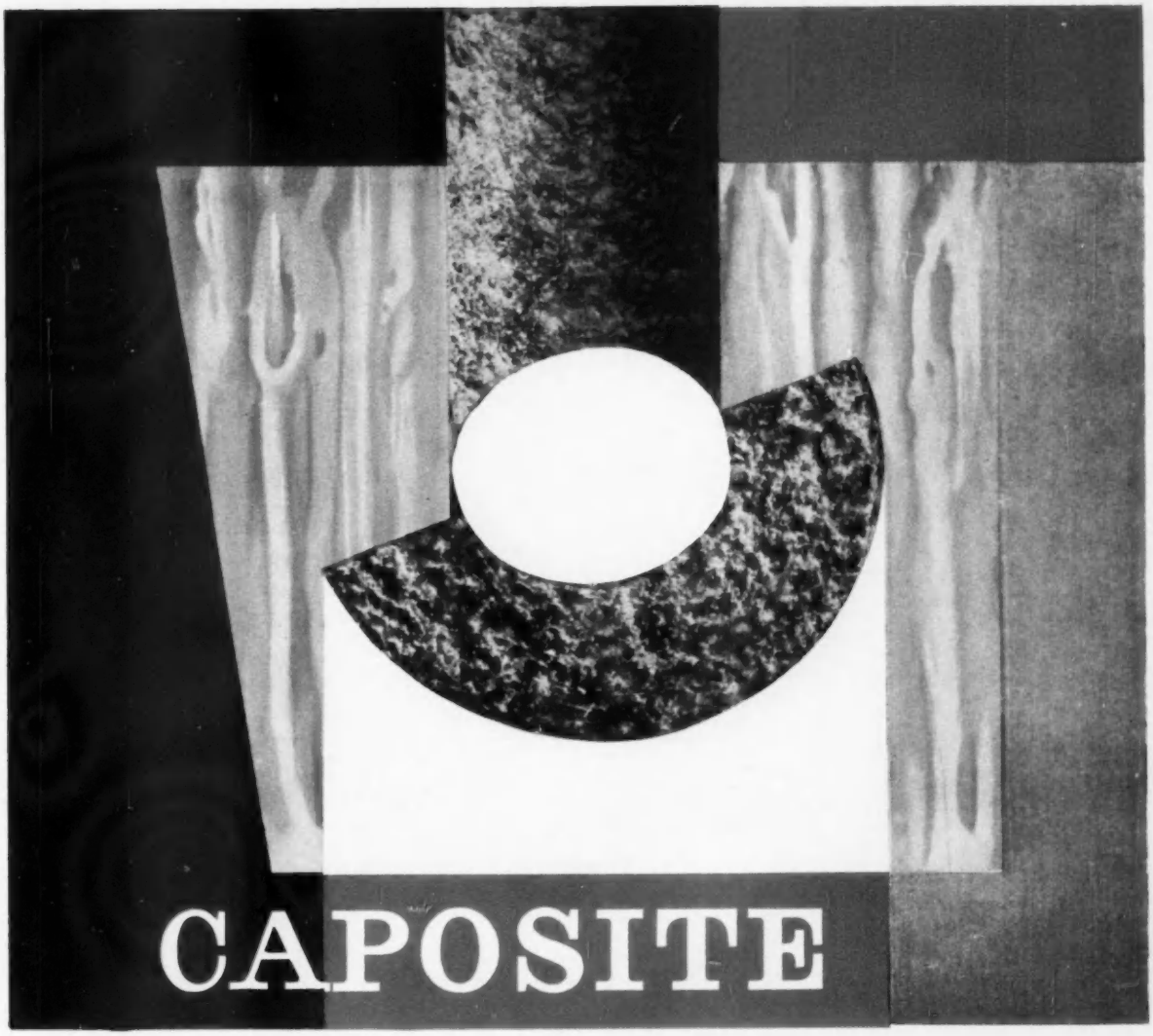

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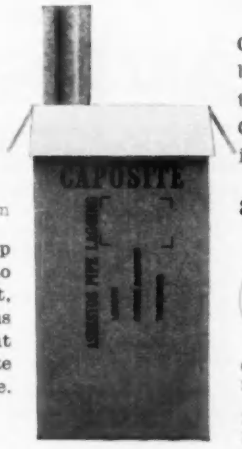
INSULATION

'efficient, economical'

Caposite insulation has high thermal efficiency due to its being made from unique long fibred amosite asbestos from the company's own mines. These long fibres give Caposite great mechanical strength, enable it to be preformed in large sizes, and to be applied as a single layer.

amosite asbestos preformed insulation



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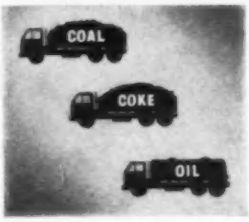

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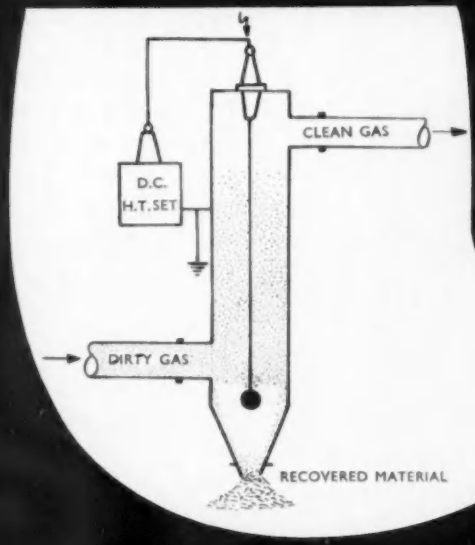

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SC217

Damaging Slag and Carbon build-up is no longer a problem

DOHMseal, applied to existing refractory linings by brush or to new linings by the "Dipped Brick" technique, forms a tough resistant glaze that retards the build-up of Carbon and Slag and extends the "maintenance free" life of the lining.

These undesirable deposits will eventually form but DOHMseal ensures their easy removal without damage to the refractory lining.

Fuel saving and reduced maintenance costs result from the use of DOHMseal, which more than pays for the small expenditure incurred.

Repair refractory linings and fabricate monolithic refractory shapes with DOHMpatch—finish with DOHMseal.

CENTRAL ELECTRICITY GENERATING BOARD

Close-up of slag adherance chipped away, showing DOHMseal treated bricks beneath. Without the application of DOHMseal the boilers need to be rebricked every six months.

By treating bricks with DOHMseal, which allows easy removal of slag, there is no necessity to rebrick for a year or more.

Write or telephone for full details:

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ONE OF THE DOHM GROUP OF COMPANIES

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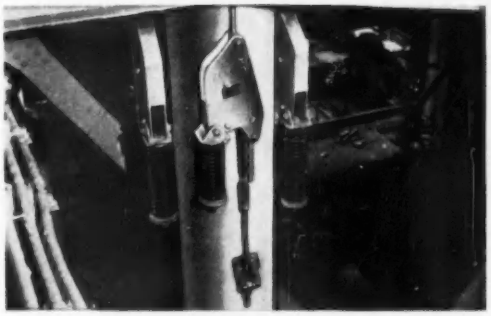

The Con-Ten system has not only been tested, but *proved* in industries and power stations all over the world. No matter what the load or the pipe movement, or the problems met, there is a Con-Ten to provide the most adequate and *permanent* support available. Loads from 100 lbs. to 14 tons and pipe movements up to 18″ can be controlled by constant tension supports in the Con-Ten range.

Contact us now for full information.

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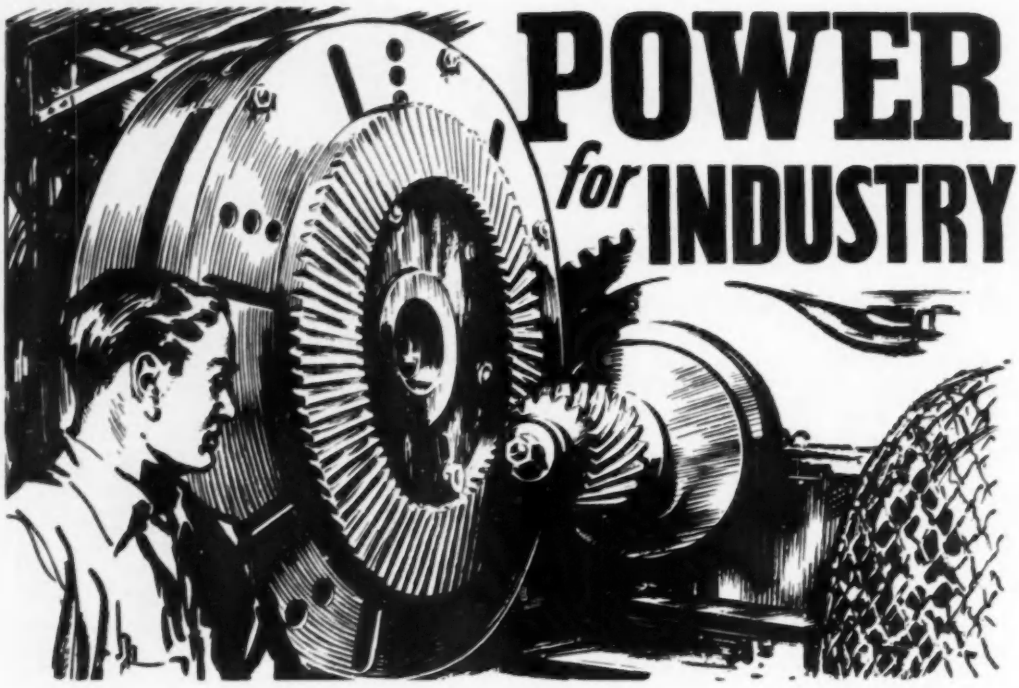

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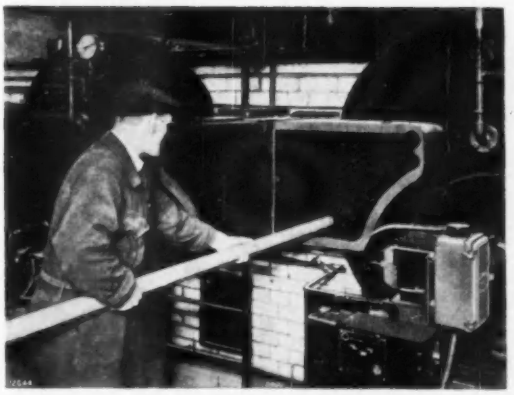
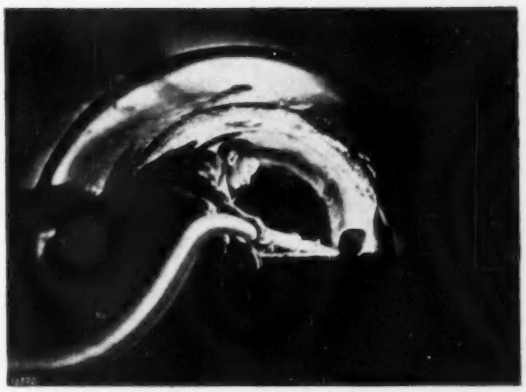
For further particulars write to our reference Z/101/J.

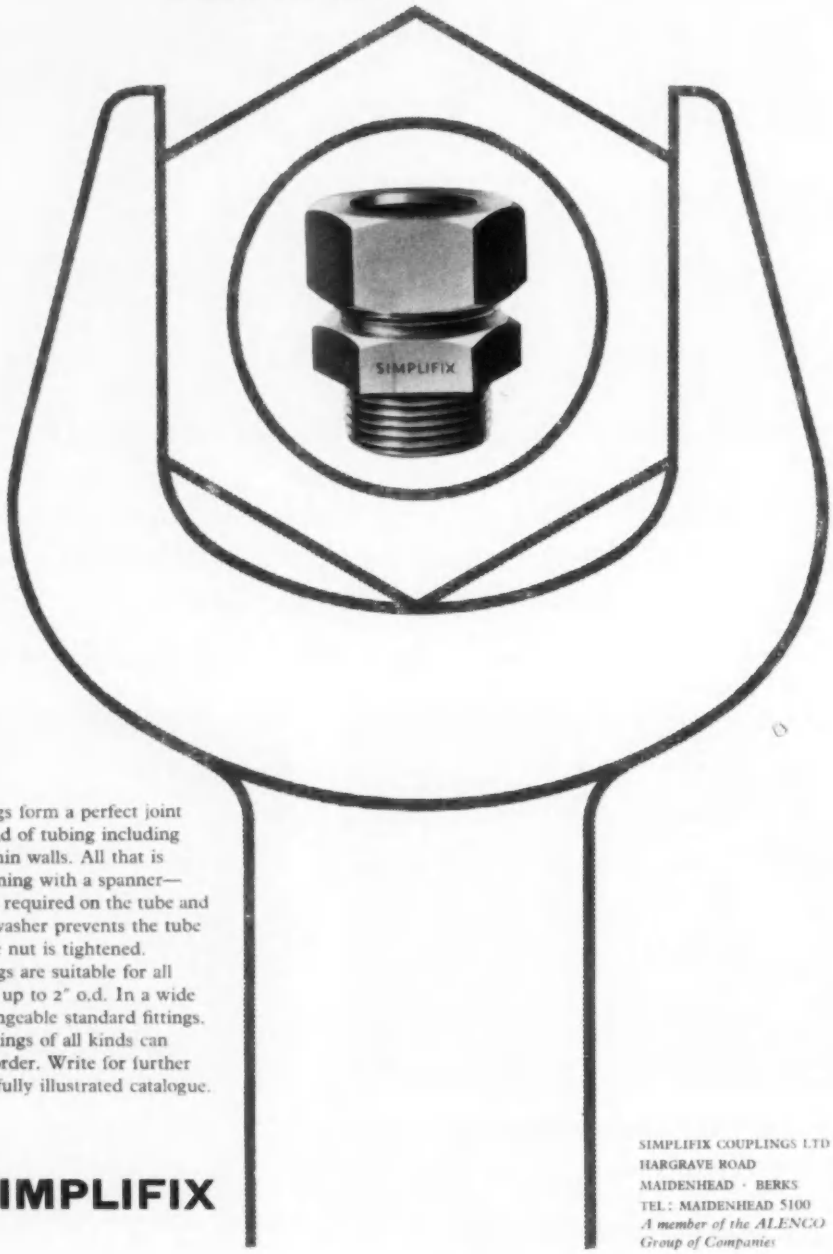




STURTEVANT ENGINEERING CO. LTD.
Southern House, Cannon Street, LONDON, E. C. 4.

So simple!

So surely SIMPLIFIX the foolproof coupling!



Simplifix couplings form a perfect joint on almost any kind of tubing including those with very thin walls. All that is required is tightening with a spanner—no special work is required on the tube and the anti-friction washer prevents the tube twisting when the nut is tightened. Simplifix couplings are suitable for all pipe line systems up to 2" o.d. In a wide range of interchangeable standard fittings. Non-standard fittings of all kinds can also be made to order. Write for further information and fully illustrated catalogue.

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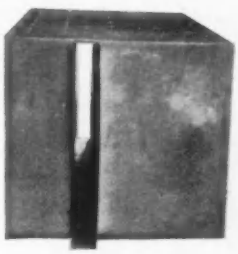
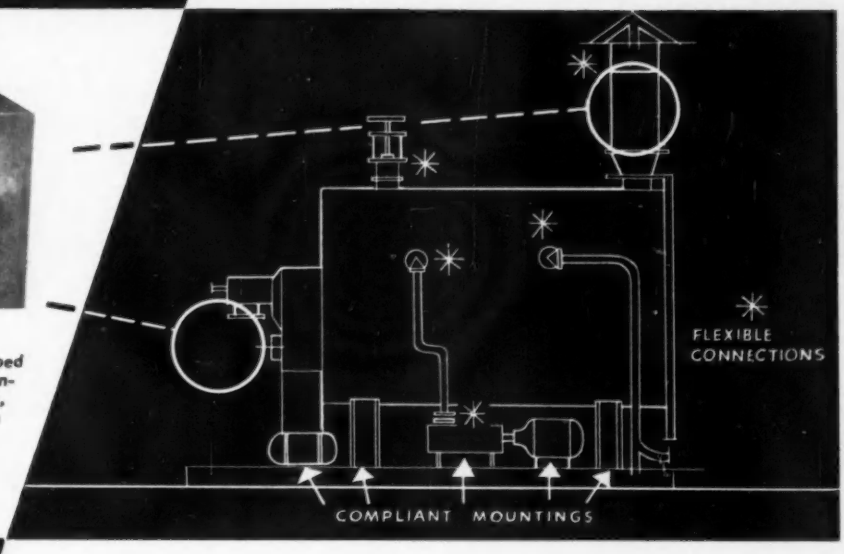
NOISY BOILERS

a new development in oil-fired boiler silencing



This newly developed "straight-through" silencer, of patented design, combines maximum attenuation with minimum resistance to a degree never achieved before.



Combustion noise from an Oil-fired Boiler, if allowed to pass up the flue, is not only likely to annoy the neighbours but can be transmitted most effectively around a building via the structure.

Furthermore, if permitted to escape through the air inlet into the Boiler Room itself, it will penetrate through every nearby door and window or other adjacent "weak spot," especially when amplified by reverberant conditions.

This new Silencer, which can be designed to give a reduction of 35 lb. down to 50 cycles if required, will now virtually eliminate combustion "rumble," normally predominant at the lower frequencies, at these two all-important sources.

With the correct compliant mountings to boiler and ancillary mechanism and flexible connections to pipes and flue, about which we are always pleased to advise, these new Silencers, individually designed for each type of installation, will provide the final answer to the noisy Boiler problem.

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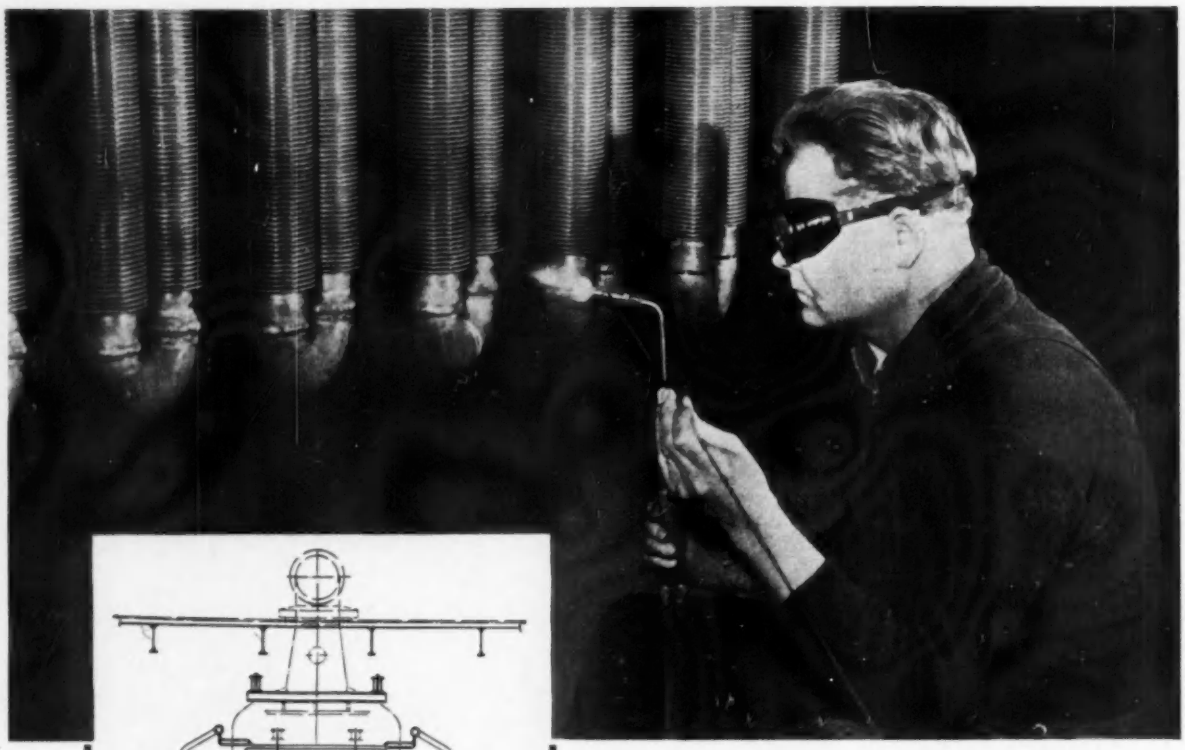

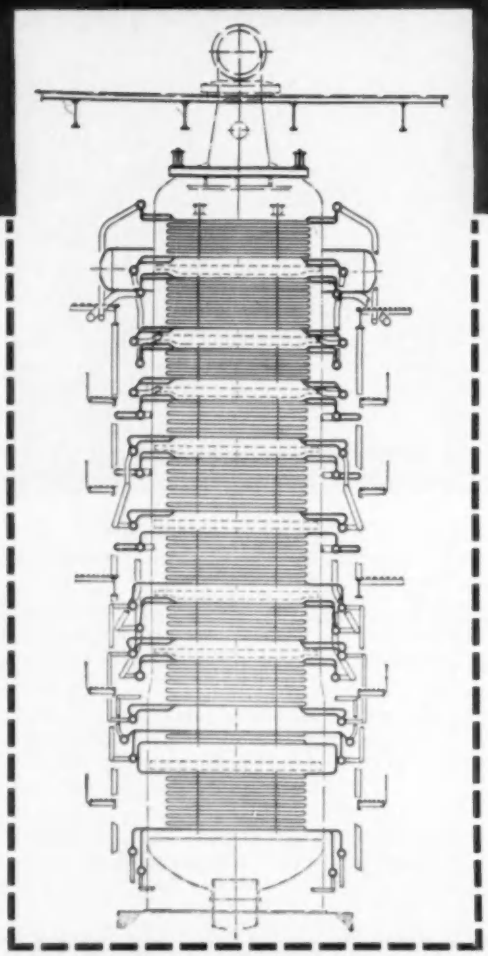

LATINA NUCLEAR POWER STATION ITALY

4,000 TUBE ELEMENTS will be fabricated in our Works from the 140 MILES of Tru-wel helically finned tubes for the heat exchangers, designed jointly by Head Wrightson & Co. Ltd. and ourselves, to be installed in the Latina Nuclear Power Station.

We are also responsible for the supervision of erection, testing and commissioning of this steam generating equipment.

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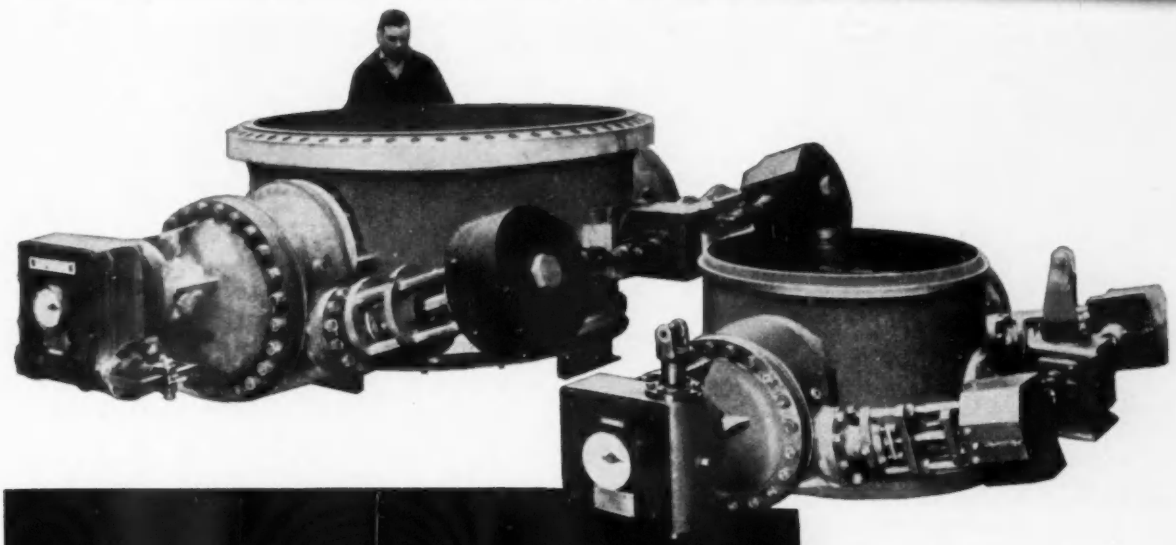
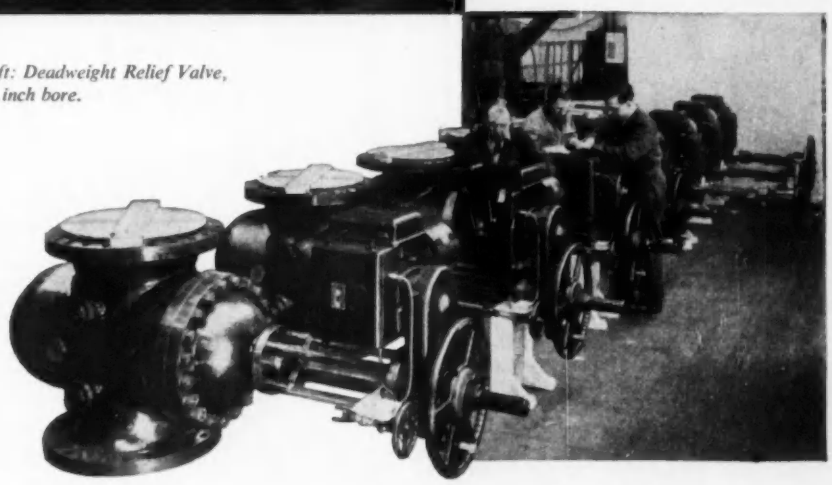


HOPKINSONS' VALVES FOR NUCLEAR POWER STATIONS

Above: "Tansphere" Valves for isolating CO_2 gas between reactor and steam generating plant. Supplied or on order for Bradwell, Hinkley Point, Latina and Trawsfynydd (Valves illustrated are 60 inch and 36 inch bore).

Below: Group of 24 inch electrically - controlled Hopkinson - Ferranti valves for a nuclear power station.

Left: Deadweight Relief Valve, 20 inch bore.



Specialised valves (some of which are illustrated) needed in nuclear power stations are naturally entrusted to Hopkinsons because of their vast experience in the manufacture of valves for exacting duties. But, additionally, Hopkinsons are supplying large numbers of their electrically controlled valves, desuperheating equipment, combined stop and isolating valves, automatic exhaust valves, steam traps and all types and sizes of stop valves.

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Hopkinsons' valves and fittings have been supplied or are on order for:

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Bradwell
Hinkley Point
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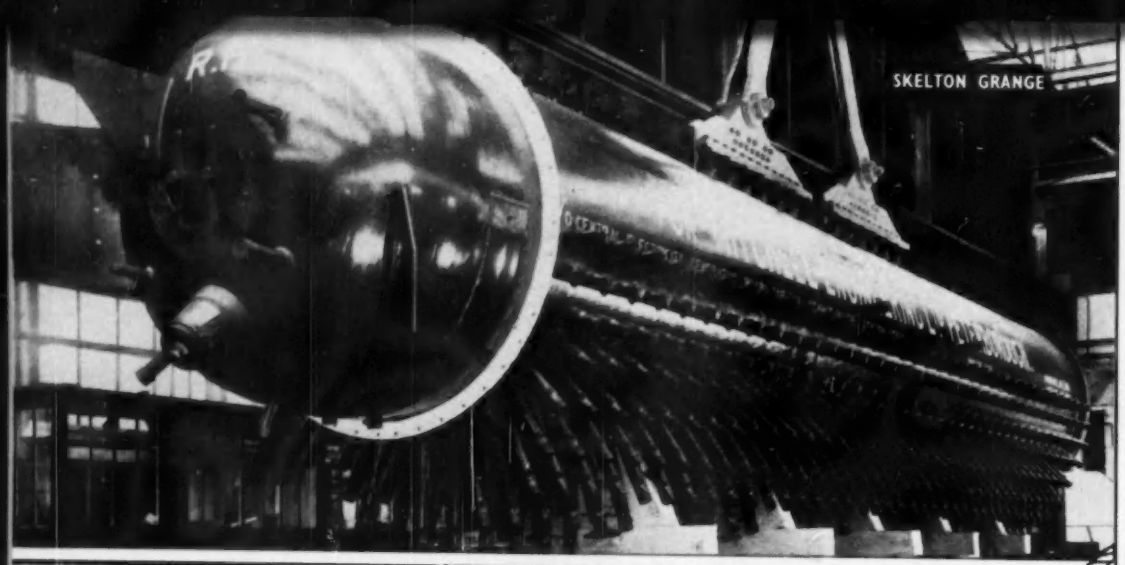
HV121



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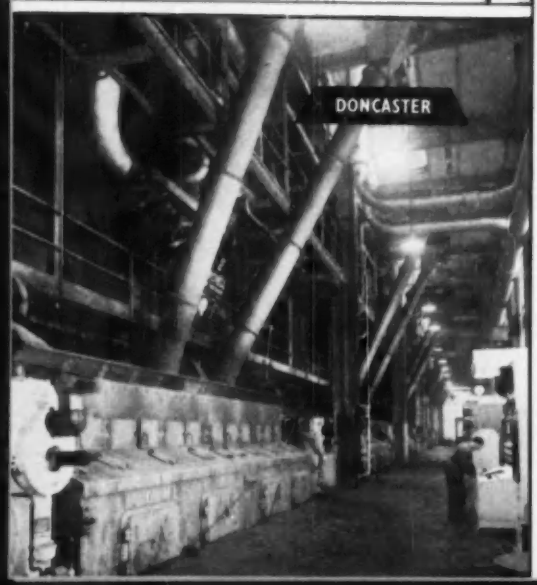

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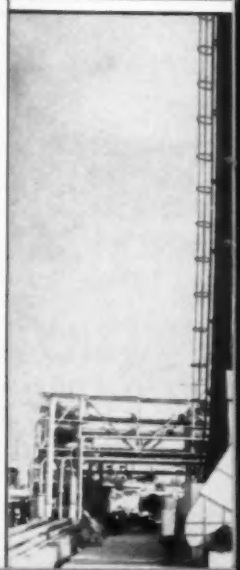


MITCHELL COMPANIES

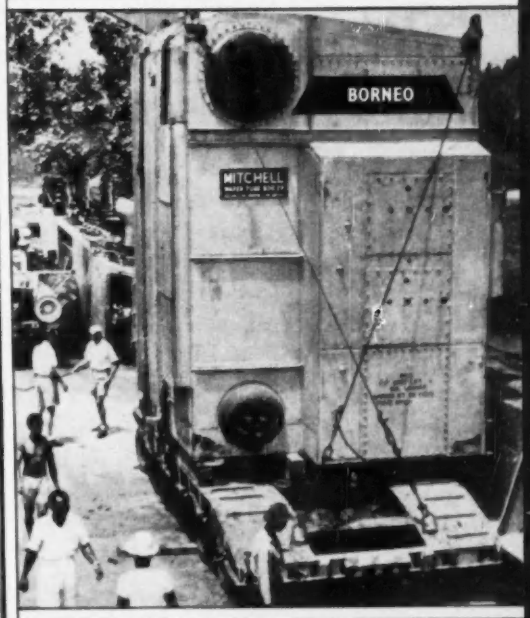
are supplying boiler units

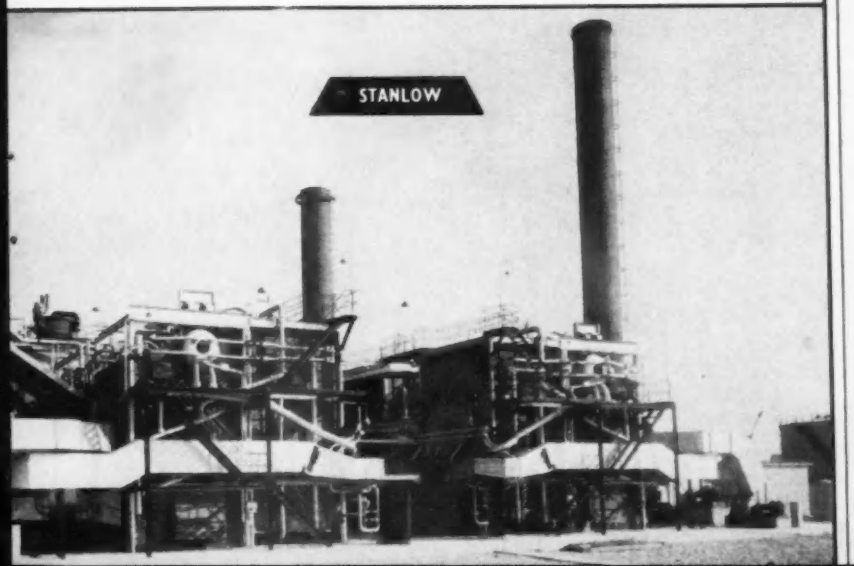
and ancillary equipment

for many public and

private organisations

at home and overseas





G.W.B. introduce the Vekos stoker

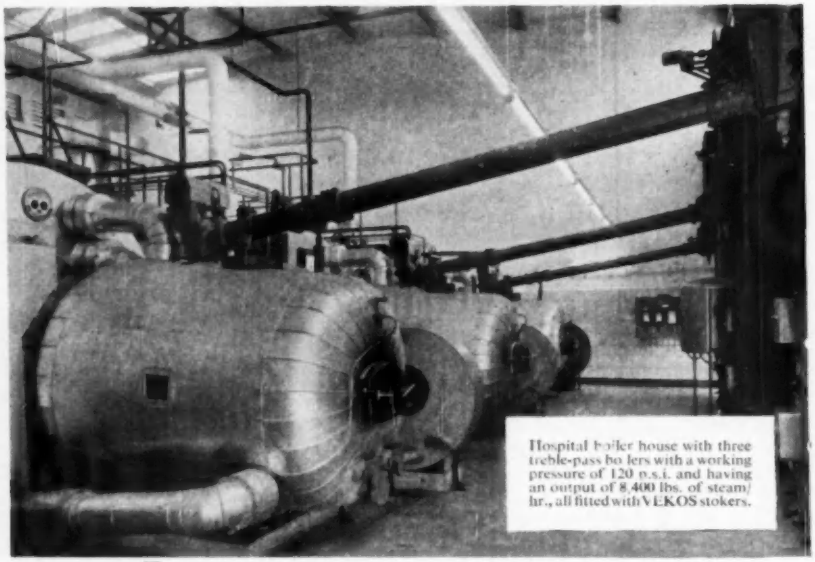
A new system of automatic coal firing

FLUE GAS CO_2 14-16% — HIGH BOILER EFFICIENCY
NO MOVING PARTS — NEGLIGIBLE MAINTENANCE

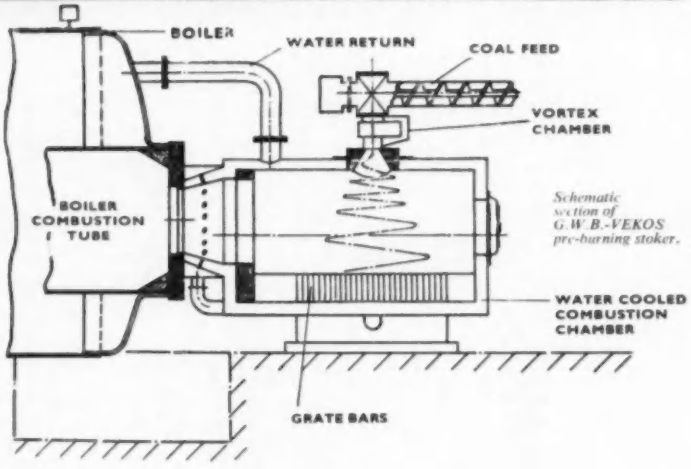
The G.W.B.-VEKOS Stoker which is based on new principles is now available. The equipment which is completely self-contained consists basically of a pre-burning unit, automatically controlled and fed, which will operate at peak efficiencies completely smoke-free, and burn bituminous fuels even of the strongly caking type. The G.W.B.-VEKOS Stoker can be fitted to almost any type of fire tube or water tube boiler, and not only increases boiler efficiency, but will add to the capacity. The usual mechanical problems associated with moving grates are non-existent, since the combustion chamber of the G.W.B.-VEKOS Stoker has no moving parts.

Automatic control of the fuel supply and the combustion air ensure a constant fuel/air ratio, providing an extremely high CO_2 value between 14-16%. The control also maintains correct relationship between fuel burnt and heat required from the boiler. The G.W.B.-VEKOS Stoker is a most attractive solid fuel firing proposition which provides extremely high efficiencies, while maintenance and the need for attendant labour is reduced to a minimum.

Fully descriptive leaflet VE.759 will be sent on request, and our Engineers are ready to discuss its application to your own particular installation.



Hospital boiler house with three treble-pass boilers with a working pressure of 120 p.s.i. and having an output of 8,400 lbs. of steam/hr., all fitted with VEKOS stokers.



Schematic section of G.W.B.-VEKOS pre-burning stoker.

GWB **G.W.B. FURNACES LTD.** (BOILER DIVISION)

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GWB 234

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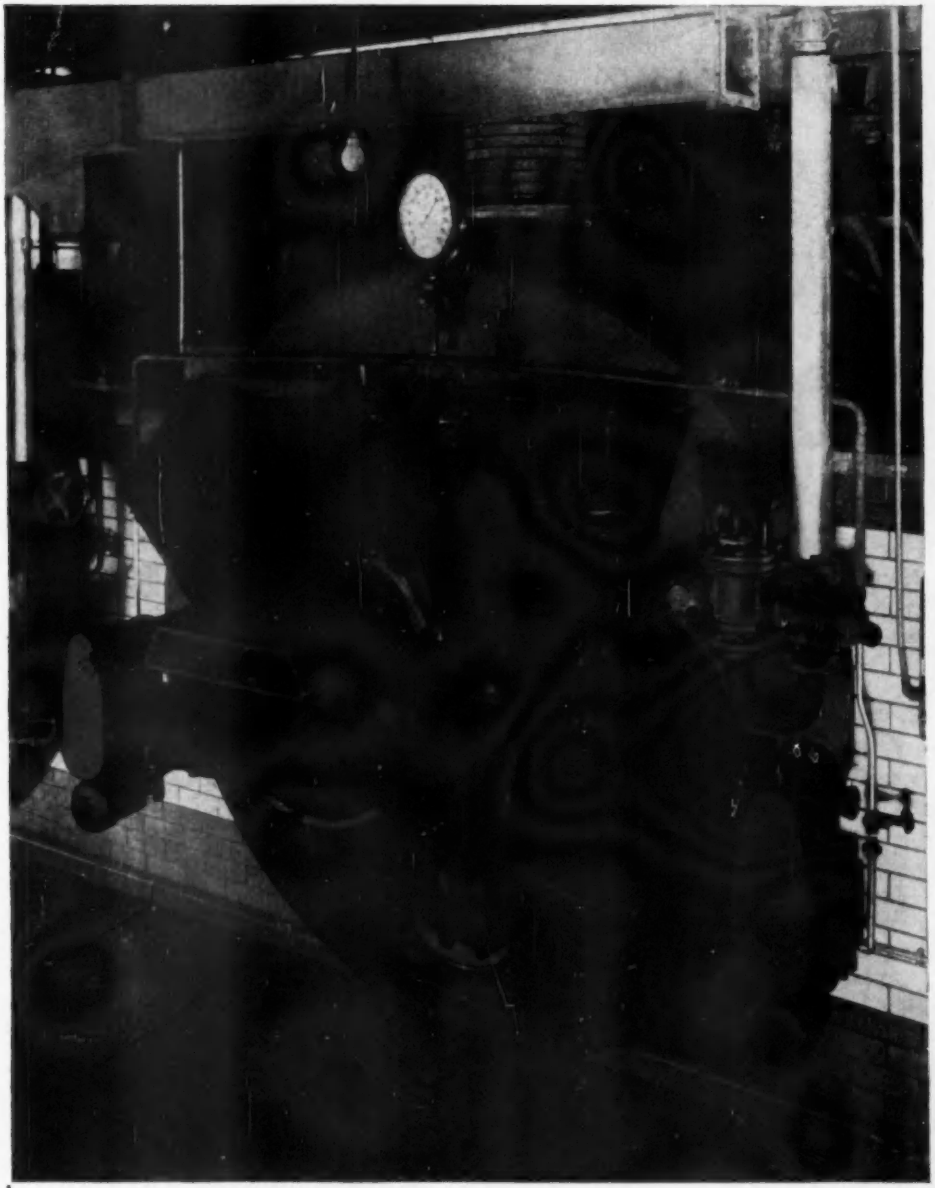

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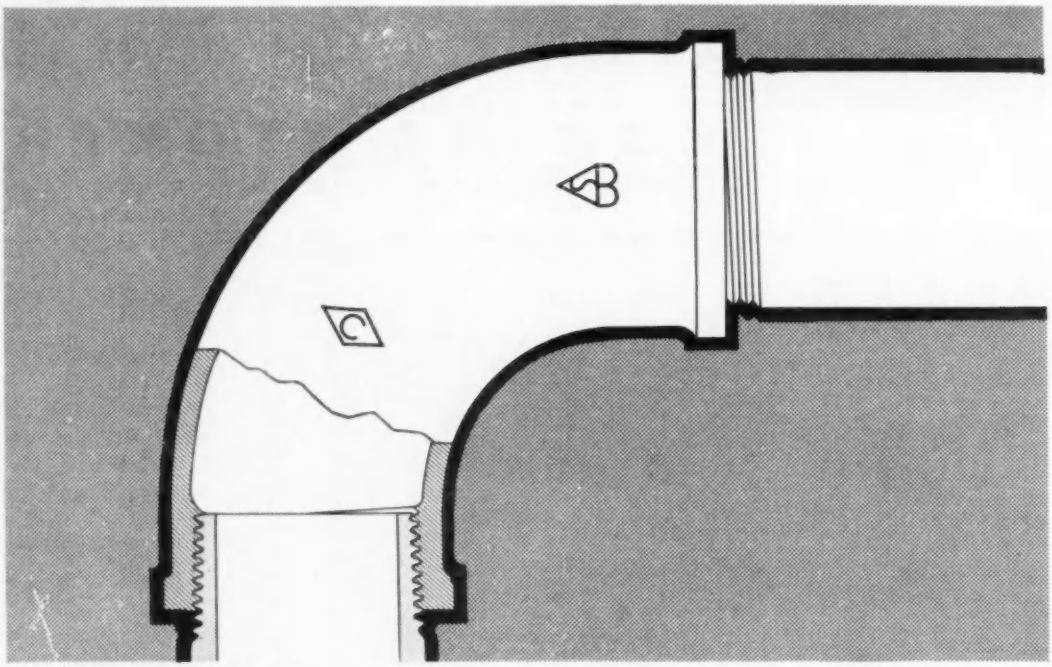

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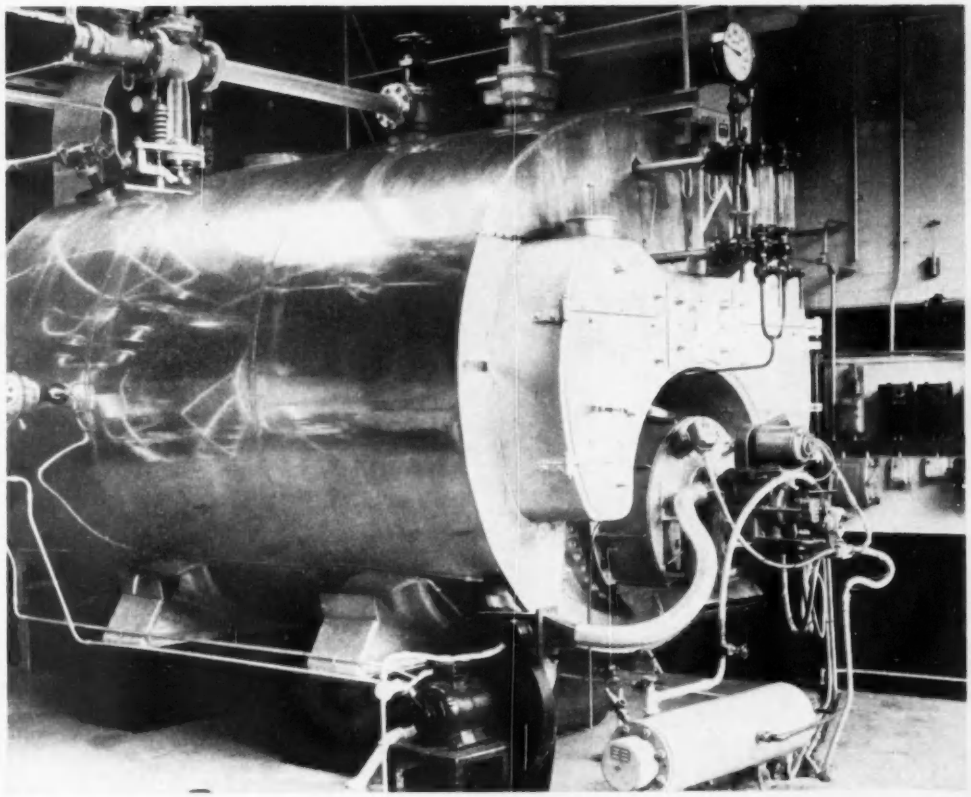

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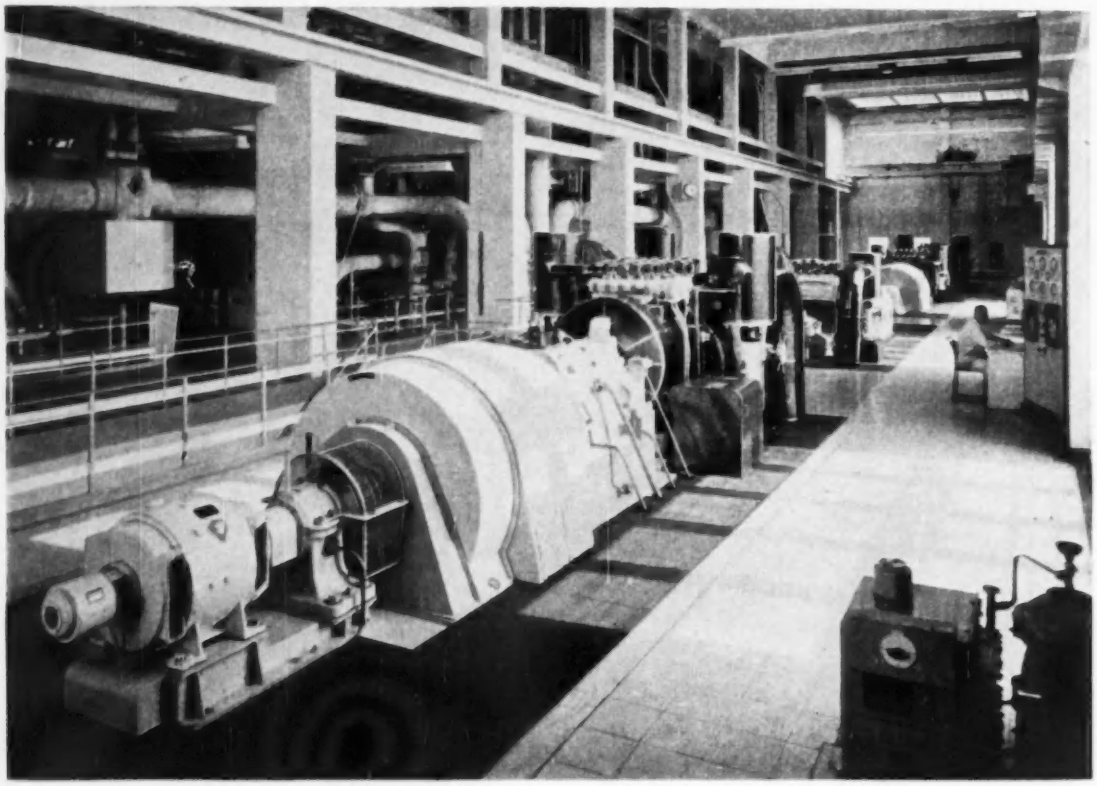
HORIZONTAL
'THERMAX' BOILERS
evaporations up to 17500 lb per hour

RUSTON & HORNSBY LTD · *BOILER DIVISION* · LINCOLN · ENGLAND

Power from Process Steam



Two 4520 kW back-pressure, and two 2500 kW extraction back-pressure turbine-generators are installed at the Merseyside Power Station of Lever Brothers, Port Sunlight, Ltd.

They are driven by the steam generated for process work and, operating in parallel with the National Grid, provide the electricity for the factory, helping to minimise overall fuel costs.

Extensive experience in the design and manufacture of extraction and back-pressure turbines enables A.E.I. to advise on applications in your particular industry.

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Engineering and BOILER HOUSE REVIEW

THE OLDEST ESTABLISHED STEAM ENGINEERING PUBLICATION

DECEMBER 1959

VOLUME 74. No. 12

Principal Contents

	Page
EDITORIAL NOTE	365
POINTS AND POINTERS	366
PRESENT-DAY FEEDWATER TREATMENT FOR HIGH-PRESSURE BOILERS	368
HIGH-PRESSURE GASIFICATION PLANT IN SCOTLAND	372
AUSTRALIAN FUELS AND THEIR UTILISATION	375
CAMBRIDGE INSTRUMENT COMPANY'S NEW LABORATORIES	377
N.I.F.E.S. FIFTH ANNUAL PROGRESS SURVEY	379
BRITISH LAUNDERERS' RESEARCH ASSOCIATION	381
RECENT EQUIPMENT AND ACCESSORIES	383
OVERSEAS STEAM ENGINEERING PRACTICE	388
LATEST POWER PLANT PATENTS	391
NOTES—PERSONAL AND INDUSTRIAL	394

The Editor will be glad to receive and consider original contributions, correspondence, etc., of a suitable nature for publication. Stamped and addressed envelopes should be enclosed for the return of any matter considered unsuitable

Published monthly by

ENGINEERING REVIEW PUBLISHING CO. LTD.
19-20, NOEL STREET, LONDON, W.1

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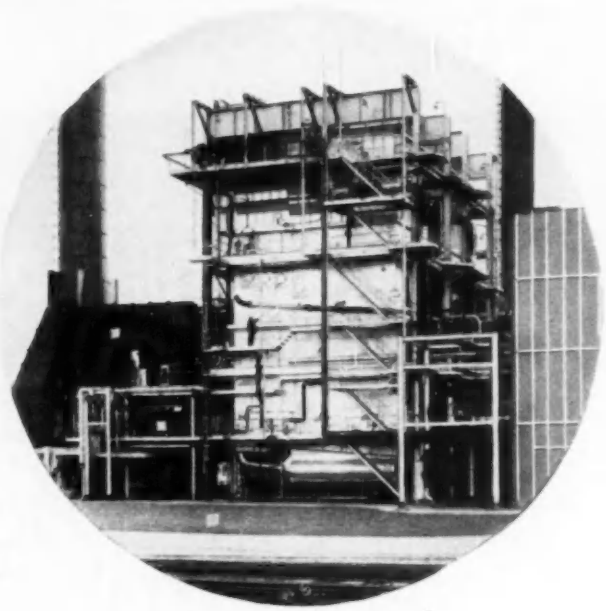
..OIL FOR Steam



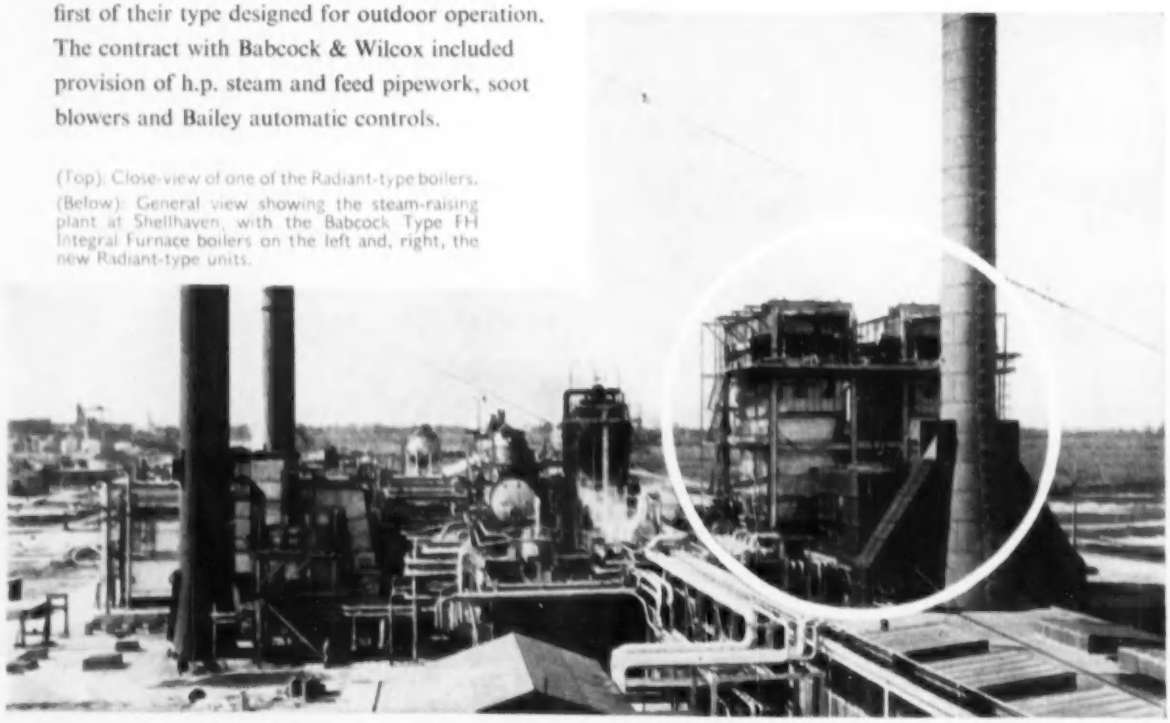
SHELL'S SHELLHAVEN OIL REFINERY is one of many important refineries in Britain and abroad using Babcock boiler plant, fired with refinery products or by-products, to supply large amounts of steam for process and power requirements.

An earlier installation at Shellhaven, of three oil-fired Babcock **Type FH Integral Furnace boilers** each supplying 130,000 lb. of steam/hr. at 256 lb./sq. in., 665°F, for processing, is now augmented by two new Babcock **Radiant-type units** each rated at 134,000 lb./hr. M.C.R., 1500 lb./sq. in., 1000°F, designed for firing with fuel-oil, asphalt or refinery gas; and supplying a 10 MW 'back-pressure' turbo-alternator, from which steam is passed out to the 256 lb./sq. in. process mains. These boilers are of the 'outdoor' type, with no boiler house, the new Radiant units being among the first of their type designed for outdoor operation. The contract with Babcock & Wilcox included provision of h.p. steam and feed pipework, soot blowers and Bailey automatic controls.

BABCOCK

Steam-Raising Plant

(Top): Close-view of one of the Radiant-type boilers.
(Below): General view showing the steam-raising plant at Shellhaven, with the Babcock Type FH Integral Furnace boilers on the left and, right, the new Radiant-type units.



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Engineering and
BOILER HOUSE REVIEW

DECEMBER 1959

VOLUME 74 No. 12

ENGINEERS IN THE WIDER SPHERE

IN his presidential address, Mr. A. C. Hartley, C.B.E., the new president of the Institution of Civil Engineers, emphasised the very great need for an adequate number of engineers who are prepared to take over the wider responsibilities in the processing industries, and whose ambitions are not limited to concentration on specialist techniques. Mr. Hartley expressed his opinion that the opportunities of the processing industries were not sufficiently well known to engineers, although their significance in the economic future of the nation could hardly be more crucial. He saw an urgent need that the ever more complicated techniques that go into modern plant should be met with a sufficiency of engineers for the processing industries who can see to it that the new plants are designed, constructed, and maintained in a manner which allows their products to be competitive with those of other countries. If engineers were not available in large enough numbers to direct those engineers carrying out this work, then it would be controlled by accountants and administrators, which the new president was sure would be agreed to be not in the best interests of industry.

In the rapidly-growing petrochemical industry the need for engineers to fill senior positions was equally important, and in the oil industry itself, where Mr. Hartley, speaking from long years of experience, predicted a capital investment of £50,000 million over the next ten years, foresaw also an urgent need for highly-qualified engineers with initiative and imagination, able to move up and become the organisers and leaders.

Unfortunately, this demand is being met far better in the United States of America and in Russia than in the United Kingdom; and the recent official and other reports show that America is training scientists and technicians at more than three times, and Russia at about ten times our annual output. The rate per 10,000 of the population is given as 6.0 in Russia, compared with 3.75 in the United States and about 3.0 in Britain. There is no doubt about the quality of the Russian engineers, particularly those in the higher grades.

Mr. Hartley pointed out that the Institution of Civil Engineers has for many years worked very closely with the other senior Institutions—the "Mechanicals" and the "Electricals," and more recently also with the Institution of Chemical Engineers and the Institute of Physics in the British Nuclear Energy Conference, and still more recently in the creation of some forty constituent Institutions, Institutes, and Societies of the British Conference on Automation and Computation.

By co-operation and by as much unification as is possible, we shall be able to exert a still greater influence on education and training, and ensure that engineering in general attracts men with first-class brains and ability, so that vast engineering works and projects can be successfully completed in the years to come. Mr. Hartley considered this to be a far better way of acquiring status than by compulsory registration which is being discussed from time to time here and in other countries.

One wonders if the rapid developments during recent years have not resulted in far too specialised courses in the universities and technical colleges, and whether these do not tend to damp down initiative and imagination, and to limit a wider interest in the arts and humanities. There is probably not much that can be done in the courses themselves, but the students, undergraduates, graduates and young engineers should be encouraged to take a keen interest in affairs around them. Assuming that we can produce the number and quality of engineers required, it is vitally necessary that those engineers at all levels who first employ them should see that they are employed on work which they are just, and only just, capable of undertaking, and then give them the benefit of good leadership and encourage them to use their imagination and initiative to the full.

Points and Pointers

REMARKABLE GROWTH OF ELECTRICITY SUPPLY

The growth of the electricity supply industry is quite remarkable, said Sir John Pickles, chairman of the South of Scotland Electricity Board, at the luncheon held in London on Friday, November 13th, following the annual general meeting of the National Inspection Council for Electrical Installation Contracting (N.I.C.E.I.C.). In 1920, there were in Great Britain, about one million consumers, whereas in 1960 there will be nearly 18 million. The use of electricity in 1920, was 4,000 million units, but it is estimated that by 1960, it will not be far short of 100,000 million units—a growth of 25 times in a period of 40 years. This growth is even more striking put in reverse, in that in 1920 the output was 4 per cent. of what it will be next year. Still more remarkable, said Sir John, is the fact that it will double again within the next ten years. Future growth will involve an immense amount of new installation work, and the extension and replacement of existing installations. That emphasises the importance of the National Inspection Council for Electrical Installation Contracting, which has been set up to maintain a Roll of Approved Electrical Contractors. Today, nearly four thousand firms have been enrolled after inspection of their premises and equipment and work carried out by them. As a result of the Council's efforts, said Sir John, the standard of workmanship has been greatly improved, to the real benefit of consumers of electricity, both in the home and in industry.

"MERLIN" RESEARCH REACTOR

"Merlin," Britain's first privately-owned research reactor, which has been built by the A.E.I.-John Thompson Nuclear Energy Co. Ltd., was opened on November 6th by the Duke of Edinburgh at the Fundamental Research Laboratory of Associated Industries Limited, at Aldermaston Court, Berkshire. This reactor uses enriched uranium fuel elements, with light water as moderator, in an aluminium tank. Criticality was reached in July this year and the power is to be increased gradually to the maximum of 5-MW. "Merlin" will have three main uses: it will provide A.E.I. with its own source of neutrons for research, testing and development; it will be the prototype for research reactors being built by A.E.I.-John Thompson for the United Kingdom Atomic Energy Authority, and for the West German Government; and it will be available for the training of nuclear physicists and engineers. The Universities of Birmingham, London, Oxford, Reading and Southampton and certain Polytechnics are to use the reactor for the instruction of senior undergraduate and post-graduate students. The projected research programme for "Merlin" includes the following subjects: (1) The study of the effects of radiation on materials. (2) The study of Cerenkov radiation as a method of power measurement and as a means of detecting escaping fission products from faulty elements. (3) Obtaining improved nuclear data on neutron and photon absorption for shielding materials. (4) Determining the critical temperature range for the accelerated creep of metals used in the reactor. (5) The study of the effect of the rate of irradiation on the life of fuel elements. (6) The study of the possibility of improving reactor safety. (7) The production of short-lived radioactive isotopes. (8) Activation analysis whereby minute quantities of impurities can be detected by irradiation. (9) The study of methods of measuring neutron energy distribution in the region of the reactor.

DOUNREAY FAST BREEDER REACTOR CRITICAL

The Fast Breeder Reactor at Dounreay establishment of the United Kingdom Atomic Energy Authority went critical on Saturday, November 14th. The reactor will go through a period of low power operation for some months, and may then be shut down for any modifications found necessary. Afterwards, the reactor will be worked up to power in stages. Construction work on this reactor started in May, 1955, and it was scheduled to start operating last year. Because of the redeployment of staff due to the Windscale pile incident, and to certain design modifications, start-up has been delayed. The reactor consists of a central core which is a hexagonal prism approximately 21 in. high and 21 in. across the flats. This is made up of about 360 enriched uranium rods in niobium cans, and is surrounded by a further 2,000 rods of natural uranium called the "blanket." The nuclear reaction in the core produces neutrons and heat, a proportion of the neutrons making their way into the blanket where they produce plutonium, a nuclear fuel which can be used in the core to produce more heat and more plutonium. Experiments have shown that the amount of fissile material produced in the core and the blanket during operation will exceed the amount burned up in the core, and the reactor is thus a breeder. In this type of reactor the neutrons are not deliberately slowed down as in a thermal reactor, i.e., no "moderator" is used, and the neutrons are said to be "fast." The small size of the core and its high heat-rating make it essential to conduct the heat away rapidly. Heat removal is achieved by placing the whole of the core and blanket in a stainless-steel vessel filled with a liquid metal coolant—sodium-potassium alloy (NaK). The NaK is circulated by electro-magnetic pumps through the vessel and through twenty-four heat-exchangers arranged radially round the vessel. The heat-exchangers consist of two concentric stainless-steel tubes, the inner one carrying the hot radioactive liquid metal which is circulated through the core, and the outer one non-radioactive liquid metal which is piped to a heat-exchanger house and used to

raise steam. The steam produced in the heat-exchanger house can either be used to drive the turbo-alternator which is installed, or the heat can be rejected to sea-water condensers. The reactor with its primary heat-exchanger circuits is installed in a concrete vault within the 135 ft. dia. steel sphere which dominates the Dounreay site. In the early stages, the Dounreay experimental reactor will be operated to provide information on the physics and control characteristics of this type of system, and this will be followed by a stage of intensive development and testing of different types of fuel elements. From the experience with this experimental reactor, much help will be derived for the design of a prototype fast power reactor, the next stage of development.

B.E.A.M.A. PUBLICITY CONFERENCE

The fourth B.E.A.M.A. Publicity Conference was held at the Connaught Rooms, London, on November 3rd and 4th. The conference was arranged by the publicity and exhibitions committee under its chairman, Mr. C. T. M. Bagnall (The English Electric Co. Ltd.), who was also chairman of the conference, and the vice-chairman, Mr. G. M. C. Peacock (Babcock & Wilcox Limited). Almost two-hundred delegates attended the conference, and about one-hundred the informal dinner on the Tuesday evening. Special visits had been arranged for those interested, to the B.B.C. television studios at Lime Grove, and to a performance of the B.B.C. programme, " This is Your Life," at the Shepherds Bush Theatre on the Monday evening. At the opening session, when Mr. D. G. Denoon (B.I. Callender's Cables Limited) presided, the speaker was Mr. Walter Nurnberg, the well-known commercial photographer. The second session dealt with " The Role of House Magazines in Industry," the chairman being Mr. H. H. Lusty (Central Information Department, A.E.I. Limited), and the speaker Mr. Bryan Samain (The Cementation Co. Ltd.). The afternoon session opened with a " Brains Trust "—there being a panel of four members, with Mr. W. L. Allison (Lancashire Dynamo & Crypto Limited) as chairman. For the final session of the day, delegates were invited to " ride their hobby horse." Volunteers were allowed to speak for not more than three minutes on a subject of their own choice, followed in each case by time for general discussion. The first day's proceedings concluded with an informal dinner, at the Connaught Rooms. At the fifth session on the following morning, Mr. W. J. Marrable (formerly Exhibition Manager, Imperial Chemical Industries Limited, and a member of the F.B.I. Committee of Inquiry into U.K. Exhibition Facilities) made an exhaustive survey of industrial exhibitions, including overseas trade exhibitions. The sixth and final session took the form of a discussion on " Publicity Overseas." Messrs. A. C. V. Clarkson (G.E.C. Limited), V. P. Marciandi (Export Manager, Electrical Division, Radiation Limited), W. M. Tribute (late Export Advertising Manager, Hoover Limited), and A. St. J. Shuttleworth (Commonwealth and East Asia Department, Federation of British Industries), formed the panel. Mr. A. H. Edney (Electrical Division, Radiation Limited) was chairman. The conference proper was concluded with a luncheon at which Mr. Bagnall presided, and introduced Col. B. H. Leeson as the guest speaker. Col. Leeson, who recently retired from the position of director of B.E.A.M.A., took the opportunity of expressing his thanks to the Publicity Department, and referred to the excellent work that it had accomplished during the past thirteen years, mentioning in particular, the production of the " B.E.A.M.A. Catalogue," and the work of the Department in connection with the Brussels Fair. Mr. S. F. Steward (director of B.E.A.M.A.) proposed a vote of thanks to Col. Leeson for his speech, and for his outstanding services to the industry.

LOUGHBOROUGH COLLEGE OF TECHNOLOGY

Work has commenced on a £2 million extension programme at the Loughborough College of Technology. " This is one of the largest and most important projects in the Government's £160 million plan for technical education," said Sir David Eccles, Minister of Education, in a message to Sir Edward Herbert, Chairman of the Governors of the College. The Loughborough College of Technology is one of Britain's eight Colleges of Advanced Technology. Some of the new buildings are expected to be ready by September, 1960, and the rest by the end of 1961. The College will then be the largest residential technical college in the country with accommodation for approximately 1,400 students in full-time and sandwich courses—50 per cent more than at present. New teaching buildings, and a " students' village," are to be erected on a 44-acre site surrounded by 150 acres of playing fields and open space. A six-storey science block will be the centre piece of the new teaching buildings ; they will include aeronautical and automobile engineering laboratories, with separate, sound-insulated test houses ; and nuclear energy engineering laboratories. There will also be a workshop engineering block, designed as a miniature factory to enable the students to study production techniques. The " students' village " will be the first of its kind in this country. About 800 of the students will live in the village in two- and three-storey terrace blocks, and in a new nine-storey block for the College's post-graduate students ; the rest of the students will live in existing halls of residence, or in lodgings. A new library is to be housed in a separate building, and will start with an initial stock of about 50,000 books. The College Union will also have its own building with a fully-equipped theatre, a games hall of 5,000 sq. ft., a dining room, a cafeteria and buttery. The original Loughborough College has now developed into four separate establishments—namely, the College of Technology, the Teachers' Training College, the College of Art and the College of Further Education. The College of Technology became a separate college in 1953, concentrating on advanced engineering and science ; it was designated a College of Advanced Technology in January, 1957. All the undergraduate students are in full-time or sandwich courses, and there is a post-graduate, full-time course, in industrial management. Seven engineering departments constitute the bulk of the College's work, i.e., electrical, production, aeronautical and automobile, chemical, mechanical, civil and workshops. An eighth department deals with applied science. The courses in the first four departments, together with the course in industrial chemistry, lead to the Diploma in Technology (Dip. Tech.).

Present Day Feedwater Treatment for High-Pressure Boilers*

By P. Hamer, B.A.†

THIS paper is concerned with industrial boilers working at 1,000 to 2,000 lb./sq. in., and about 550 deg. F. (288 deg. C.) to 640 deg. F. (338 deg. C.), generating power and steam for manufacturing processes, and thus having a high make-up of treated water as compared with the closed feedwater systems in power station boilers where little steam is lost. In the former case the size of the water treatment plant for boiler plants of comparable evaporation, and consequently the capital and chemical costs for treating a particular water, are much greater than for power station boilers.

For example, the installed cost of a hot lime-base exchange plant to provide 20-25 per cent. make-up to 900 lb./sq. in. boilers each evaporating 65,000-82,600 lb./hr., was about £25 per 1,000 lb./day treated water capacity. The output of the water plant is 4.4 million lb. of water per day reducing the hardness of the raw water from about 250 p.p.m. (parts per million) $CaCO_3$ (calcium carbonate) to 0.5 p.p.m., and the salt content from 350 p.p.m. to 250 p.p.m., SiO_2 (silica) from 10 to 1.5 p.p.m.

The installed cost of a de-ionisation plant consisting of cation, anion, and mixed-bed units to provide 1½ per cent. make-up to 650 lb./sq. in. boilers each evaporating 60,000-110,000 lb./hr. was about £45.7 per 1,000 lb./day treated water capacity. The plant produces 318,000 lb./day of very pure water containing less than 1.0 p.p.m. of dissolved salts (SiO_2 0·05 p.p.m.), from a raw water of similar type to the previous example and containing some 140 p.p.m. hardness and 230 p.p.m. salts.

On a larger scale is an estimate for clarification and two stage de-ionisation and silica removal plant of about £38 per 1,000 lb./day treated water capacity, to supply about 19.54 million lb. water per day as 80 per cent. make-up to boilers working at 1,700 lb./sq. in. evaporating 530,000 lb./hr. each.

When comparative running costs are considered the situation is very complicated and will change with the operating and other local conditions in each factory, as well as with the composition of the raw water, so that nothing but a most careful study of each case can give a satisfactory answer. Chemical costs alone give no indication of comparative running costs; for instance, the estimated chemical costs for treating the water in the first example by hot lime-base exchange or de-ionisation was about 1.0 and 35.0 pence per 10,000 lb. respectively, a difference factor of thirty-five, whereas the total running costs, including the preliminary clarification treatment needed before de-ionisation, but excluding cost of raw water and plant capital depreciation, were 13.0 pence per 10,000 lb. (actual) for hot lime-base exchange and 54.54 pence (estimated) for de-ionisation. Carrying the estimates a stage further to take into account the loss of heat and power in blowdown, put at 91 pence per 10,000 lb. of water leaving the boiler, the cost of 75 per cent. make-up hot lime-base exchange treated water with 12 per cent. boiler blowdown worked out at about 196 shillings per 10^6 lb. of steam compared with 294 shillings for 63.5 per cent. make-up of de-ionised water and 0.5 per cent. blowdown.

Other factors may also influence the choice and cost of treatment; for example, in the case quoted there was an ample supply of water from cooling plant at 80 deg. C. which could be treated by the hot process but not by de-ionisation, which cannot at present be worked at temperatures above about 50 deg. C. on account of damage to the anion resins. The development of an anion resin capable of working at 100 deg. C. would be a major advance in the usefulness of this process. Again, if the raw water is dirty, it must be clarified before ion exchange to protect the resins from deterioration due to clogging, or absorption of organic matter. The hot process clarifies and softens in the lime treatment tank and is also simpler to operate and control, but does not reduce silica to the same extent as de-ionisation.

Evaporation is, of course, the oldest method of preparing condensate quality water for boiler feedwater make-up, but the high capital cost per unit of water produced, and difficulties in preventing scale which reduces efficiency, have prevented it being seriously considered for large volumes of water. Recently, however, both these items have been greatly diminished by the use of multi-stage flash evaporation, and it now looks as though this process may well become a very serious competitor of de-ionisation. Running costs of evaporation must be worked out in each case as they depend so much on the cost of steam at the point of abstraction.

Discussing the quality of water used in high-pressure boilers, the author states that a standard composition is not a very practical concept because boilers are not alike. Two tables are, however, included, giving examples of boiler water compositions actually in use or recommended from experience. The first covers boilers with operating pressures from 1,000-1,500 lb./sq. in. with high make-up requirements, as may be expected in industrial plants generating steam for power and heating. Here, the examples show that in this pressure range it is possible to use feedwaters of fairly high salt content, but the second table shows that at higher pressures the trend is to limit the salt content severely.

Control of steam purity

The criterion for the boiler plant is to supply steam at a given pressure and temperature and in a condition such that it will not cause corrosion or deposits in superheater turbines or process plant. Corrosion is due to gases, carbon dioxide, oxygen, and occasionally sulphur dioxide,

*Abridgement of a paper presented to The Institution of Mechanical Engineers, in London, on October 21st, 1959.

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whereas solids such as boiler-water salts and silica mechanically entrained in the steam or dissolved in it are responsible for the deposits.

Condensate containing carbon dioxide and oxygen is acid, though sometimes the acidity is at any rate partially counteracted by ammonia liberated from alkaline boiler or evaporator water containing organic matter. It is a matter of concern, not only because of damage to condensate piping but also because the corrosion products are carried forward and choke the pipes, or accumulate in the boiler when the condensate is returned as feed, and corrosion may occur underneath them.

The carbon dioxide is usually derived from the decomposition of sodium carbonate in the boiler water, or bicarbonates in the boiler or evaporator feedwaters. The first step is, therefore, to treat the feedwaters by softening processes which reduce carbonates and bicarbonates to a minimum; for example, lime followed by base exchange, de-ionisation, or hydrogen ion exchange combined with base exchange and carbon dioxide removal. Secondly, the dissolved oxygen should be reduced to 0.01 p.p.m. or less in a standard feedwater deaerator. Thirdly, since tests on working boilers in the United States of America seem to show that the dissolution of iron and copper in feedwater systems is least when the pH value of the condensate + make-up water measured at room temperature is 9.0, it is recommended that this condition is maintained by the addition of ammonia or volatile amines or soda alkalis to the boiler feedwater, using the latter when the make-up is high.

Ammonia has been used in Germany but it is recognised that the amount must be limited, since their experience is that it attacks copper and its alloys in the presence of oxygen, but in the virtual absence of oxygen its concentration may be as high as 10 p.p.m. without bad effect, The ammonia can be added to the boiler or evaporator feedwater as ammonia liquor or an ammonium salt, or it can be generated in the boiler from the decomposition of hydrazine by the addition of more than is needed for de-oxygenation. On the other hand it has been said that on account of its volatility ammonia gives little protection in the wet areas of turbines and in the higher temperature feedwater heaters. Less volatile amines such as cyclohexylamine and morpholine are now being used.

Ammonia and the amines act by forming carbonates or bicarbonates with the carbon dioxide, and if the condensate is returned to the boiler these compounds liberate amine and carbon dioxide again. Both are lost to some extent in blowdown, and the treatment is, therefore, best used when the carbon dioxide in the steam is low and the feedwater is comparatively pure. Full-scale tests comparing the two amines seem to show that they are equally effective in preventing iron and copper corrosion.

In Britain both amines are sold as 40 per cent solutions in water, and the ratio of amine to carbon dioxide (expressed as calcium carbonate) needed to give a pH of 9.0 at room temperature is about 1.5. Data are not yet available for higher temperatures. They are said to be stable up to about 1,000 deg. F.

Deaeration of boiler feedwater

The removal of oxygen from feedwater is the most important step to prevent corrosion in economisers and other pre-boiler equipment, as well as in the boiler itself and the turbine and condensate return system. For high-pressure boilers it is usual to conduct this operation in two stages, the greater part being removed in deaerators or deaerating heaters working under vacuum or at high temperatures, for example, 160 deg. C. (320 deg. F.). It is understood that suppliers of modern plant will guarantee the reduction of dissolved oxygen to about 0.005 p.p.m., but it is important that the plant shall be designed to achieve this under all normal variations in boiler operation.

Many high-pressure boiler plants in the United States of America are reported to be free from corrosion with mechanical deaeration alone, provided, of course, that it is consistently maintained at the limit of 0.005 p.p.m. There is, however, always the risk of in-leakage of air at one point or another in the system, and hence it is better to supplement mechanical deaeration with chemical reducing agents such as sodium sulphite or hydrazine, as a safeguard against leakage and variations in deaerator performance.

Solids in steam : deposits

Solids are introduced into steam either as a result of entrainment of boiler water or dissolution of silica and boiler-water salts in saturated steam. These solids can deposit in superheaters causing failure, or on turbine blades where they reduce the output. The entrainment or " carry-over " of boiler water is usually promoted by operating conditions such as high water levels, sudden increases in steam load, leakage of water or very wet steam past baffles in the steam/water drum, and high concentrations of dissolved salts in the boiler water which encourage the formation of a layer of foam. The effect may be produced by any one or a combination of these conditions.

The maximum concentration of boiler salts recommended for drum boilers working at 1,000-2,000 lb./sq. in. ranges from 1,500 p.p.m. at the lower pressure to about 300 p.p.m. at the higher. The figures assume steady load conditions at or below the maximum continuous rating specified by the manufacturer. They are, however, only a guide based on general experience of many boiler plants working under a variety of conditions, and for the control of individual plants it is best to fit steam sampling probes coupled to apparatus for measuring and recording the conductivity of the condensate.

The conductivity of degassed condensate from a good quality steam containing less than 0.5 p.p.m. boiler salts will be about 1-3 Dionic units, and the boiler water concentration should be maintained at the highest level which will produce this quality under normal boiler operation. Should the steam quality deteriorate the boiler should be blown down, and if the deterioration is due to high boiler-water salts, the steam quality will then improve.

Boiler-water salts and silica are now known to be soluble in saturated steam and to a greater extent in superheated steam. Sodium chloride is the most soluble of boiler-water salts, but at 2,000 lb /sq. in. and below, the amount taken up at normal boiler-water concentrations is said to be negligible. Silica, on the other hand, is more soluble and can form hard deposits on the low-temperature stages of condensing turbines below about 500 deg. F. These deposits can be very difficult to remove, needing sand-blasting or hot strong caustic soda. Determinations of the solubility of silica in satur-

ated steam have shown that it is proportional to the concentration in the boiler water and increases with temperature, but decreases with increase in boiler-water pH.

As a result of this work and general experience in the United States of America, it now seems agreed that hard deposits of silica will not be formed if the silica content of the steam is below 0.025 p.p.m. The figures given in the accompanying table show the concentrations of silica (SiO_2) (p.p.m.) in boiler water found to give 0.02 p.p.m. SiO_2 in steam.

CONCENTRATION OF SILICA IN BOILER WATER GIVING 0.02 P.P.M. SILICA IN STEAM

Boiler pressure, lb./sq. in.	1,000	1,200	1,400	1,600	1,800	2,000
Boiler water pH 10	6	4	2.5	2	1	0.8
11	11	7	5	3	2	1
12	20	13	8	6	4	3

These figures have been determined in laboratory apparatus under conditions of experiment made difficult by the high pressures and temperatures, so that they must be regarded as an order of magnitude for full-scale plant in which equilibrium distribution of silica between steam and water may not be attained. A small amount of carry-over into the superheater may increase the concentration in the steam. It will be noted, however, that the silica concentrations in the boiler water are very low, which calls for a feedwater-softening treatment which also removes silica, and the boiler blowdown must be controlled by the concentration of both silica and salts. It is the author's view that the choice of de-ionisation instead of other processes is often determined by the desire to reduce silica to very small amounts, and not because of any special need to remove all salts. For greater flexibility in the treatment of feedwater a process is needed, preferably of the filtration type, which will remove silica alone under either cold or hot conditions.

Silica and iron oxide in steam condensate samples must be determined chemically as they do not contribute to the conductivity. The simplest procedure is to keep the concentrations of silica below the figures given in the table. It should also be emphasised that these figures refer to scaling in condensing turbines and where, as in many industrial boiler plants, turbines exhaust to process, no doubt some relaxation of the figures is possible, but unfortunately there is little or no recorded experience as a guide.

Silica can enter the boiler in other ways than in the feedwater, especially when the boiler is being erected and, on starting up, the concentration in the boiler water may be quite high, for example, 100 p.p.m. or more, and heavy blowdown may be needed for a week or two to reduce this.

Steam washers

Silica and salts in steam can be reduced to very small amounts by "scrubbing" the steam with clean water, such as good quality condensate. As an example of the results to be obtained may be mentioned a washer designed in Holland and fitted to boilers operating at 1,250 lb./sq. in., which has enabled them to work at the surprisingly high boiler-water concentration of 8,000-10,000 p.p.m. for a number of years without detriment to superheaters or turbines. The boilers are banked at weekends and some solid could be removed then by condensing steam, but tests have shown the steam to contain less than 0.02 p.p.m. silica.

Other types of washer are supplied by various boiler manufacturers, but it is clear that there is a good deal of useful work to be done on these washers which, if developed to a point where they can be easily installed and worked, will make it easier to control steam purity, and make the choice of feedwater treatment and the operation of boilers more flexible, since it will not be necessary to insist on such low salt or silica concentrations in the boiler water as at present. They will also save blowdown.

Control of corrosion in boilers

Steel and water react at boiler temperatures liberating hydrogen and forming ferrous hydroxide

$$Fe + 2H_2O \longrightarrow Fe(OH)_2 + H_2$$

The ferrous hydroxide then changes to magnetite which, if precipitated close to or on the metal surface, adheres and forms a layer which usually stifles further rapid attack.

$$3\,Fe(OH_2) \longrightarrow Fe_3O_4 + 2H_2O + H_2$$

This reaction takes place more readily in the presence of copper, nickel, or platinum.

The working life of the boiler, therefore, depends on the continuity and stability of this magnetite layer, and if it is cracked or removed by chemical action or thermal or mechanical shock, the underlying steel is exposed to further attack. The subsequent course of events will be determined by the local chemical and physical conditions at the break, since if these favour the formation of fresh magnetite close to the metal the break will be self-healing, but if the fresh magnetite is precipitated a little away from the break, corrosion will persist.

Dissolved oxygen and alkalis in the boiler water also play their part in preserving or destroying the magnetite film. Oxygen will convert ferrous hydroxide into the insoluble ferric form and so hinder film repair. Its removal is, therefore, the most important countermeasure to corrosion. The maximum quantity which can be tolerated in a boiler water is not known, but proposals for research on this point have been put forward. Meanwhile, the usual recommendation is to reduce oxygen in the feedwater to 0.005 p.p.m. by physical means, and to supplement this by the addition of sulphite or hydrazine as an extra safeguard. Both measures must be applied continuously and consistently.

Caustic soda and sodium phosphate may be expected to preserve the magnetite and assist healing by increasing the concentration of hydroxyl (OH) or phosphate (PO_4) ions close to the metal surface and promoting the formation of fresh magnetite (or perhaps iron phosphate) in the most favourable position. The concentration of OH ions present in "pure" water is insufficient for this purpose. Not enough information is available to determine the most advantageous concentration, but the author prefers concentrations of 40-60 p.p.m. caustic soda or sodium phosphate, or that caustic soda shall constitute about 10 per cent. of the total dissolved solids when these are above 600 p.p.m. Much higher concentrations of caustic soda can destroy the magnetite and a recently concluded study of the effects of caustic soda alone on mild steel at boiler temperatures under static conditions, shows that at 288 deg.-338 deg. C.

steel is rapidly attacked by caustic soda concentrations above about 50,000 p.p.m. with formation of magnetite and other corrosion products which did not appear to be particularly protective. It remains to be seen what will happen when other boiler salts are present.

Corrosion in the absence of oxygen

To account for certain cases of corrosion in high-pressure boilers which have apparently occurred in the absence of dissolved oxygen, the existence has been established, in parts of the boiler, of much higher concentrations of boiler-water salts than in the boiler drum, due to special local conditions. It is also suggested that concentration of boiler-water salts may be expected underneath loose deposits of calcium and magnesium phosphates precipitated in the boiler, or of iron oxides carried into the boiler as a result of the corrosion of feed lines, tanks, etc. The water within the deposit concentrates by evaporation because it is not easily replenished by the main body of boiler water, and at the same time the deposits encourage overheating of the metal beneath them, so that the protective layer of magnetite may crack, exposing fresh iron to attack by caustic soda in the concentrated solution.

Failures due to this type of corrosion are only likely to occur in tubes where deposits can lodge easily because the water flow is not high. The remedies are to reduce hardness in the feedwater and corrosion in the pre-boiler system so as to diminish the total amount of solid depositing in the boiler as far as possible, and to improve the circulation of water in the tubes.

Corrosion failures in high-pressure-boiler furnace-wall tubes which are substantially clean have been explained on the assumption that concentrations of soda and other boiler-water salts can occur in the almost static film of water next to the metal, the salts being fed into the film by evaporation of boiler water at the steam-metal-water junction which exists for the short time a steam bubble is still attached to the metal surface. When such conditions persist, it is suggested that the magnetite layer on the metal slowly thickens and eventually cracks, probably by repeated over-heating and quenching, exposing fresh iron. Thickening can also be ascribed to the migration of iron ions through the magnetite layer to react with water at the surface, and OH ions moving inward to the iron-magnetite interface. In some cases the tube metal has been embrittled owing to the action of the hydrogen generated, and the tube has failed with a clean thick-walled fracture. The attack is localised, and seems to be associated with high heat input and inadequate water flow. These conditions could arise as the rate of heat transfer approaches that of transition boiling or film boiling, and it seems wise to err on the side of having too much rather than too little heating surface and to avoid local hot spots. There may be, therefore, a problem of boiler design as well as of operation.

Idle boilers

Unless special precautions are taken, some corrosion is inevitable when a boiler is drained and allowed to stand, because some tubes or headers cannot be completely emptied and the walls of tubes and drums are wet. During normal boiler inspections it is common to find a certain amount of corrosion in the form of small rust blisters on the roof of the drum and elsewhere, but there is no reason to believe that these are more than superficial. If a boiler is left open and wet for a considerable time, however, there will be a risk of more severe corrosion, and that the attack, once established, may persist during work. In the author's experience it is doubtful whether much evidence has been found that corrosion started during idle periods has been responsible for subsequent failures, nevertheless it is good practice to take such precautions as are easy and not too expensive. The two main periods which usually cause concern are during erection and lengthy shutdown.

It is not uncommon to find that some corrosion of tubes and drums has occurred during transit and erection, and this will be aggravated after hydraulic test, as there may be an interval of three to four months between this test and putting the boiler to work. If the boiler is to be acid cleaned before working, or after a short period of steaming, as is becoming common practice in the United States of America, special protection after hydraulic test is probably less necessary.

It is recommended that the hydraulic test is carried out with alkaline water (pH 9.0 to 9.5) containing 1,000 p.p.m. of hydrazine, and this solution may be used for protecting the surfaces during standing periods, between " boil out " and steaming or at other times, even if these last for some weeks. The boiler should be drained and refilled with normal feedwater before steaming.

Hydrazine is polluting to streams, being toxic to fish in quantities of about 0.7 p.p.m., and should be destroyed by the addition of a little excess chlorine in the form of hypochlorite. The excess chlorine may be detected with starch iodide paper, and since it also is toxic to fish it must be destroyed by adding a little thiosulphate.

Acid cleaning

The modern industrial high-pressure boiler is often so constructed that it can neither be properly inspected nor can it be cleaned by the type of mechanical tools formerly used. Boiler owners are, therefore, being driven to extreme efforts to eliminate from the feedwater any substances which might precipitate in the boiler and stick to the heating surfaces, or which might be carried in suspension in the feedwater.

Despite the best efforts, some iron and copper are likely to enter the boiler from the feed system, and in the United States of America many people have countered this by acid washing, using acid containing a corrosion restrainer, but the choice of the proper time is guesswork as no satisfactory means of determining the thickness of deposits on the water side of tubes has been developed. It has been stated that the period between acid cleaning of United States Public Utility boilers varies from less than one year to four and five years.

The question of acid cleaning of new boilers has been widely discussed but without any very definite conclusions. In this case the cleaning is intended to remove mill scale as well as iron oxide derived from corrosion occurring during transit, erection and hydraulic tests. It is understood that in the United States of America it is quite usual to delay the acid clean until the new boiler has been at work for a short while during which time oxide will be detached from the pre-boiler system and accumulate in the boiler. The pre-boiler system cannot be cleaned easily.

(*Continued on page* 374)

High-Pressure Gasification Plant in Scotland

IN the April, 1958, issue of this journal, we published some particulars of the order placed by the Scottish Gas Board for the installation of a Lurgi pressure-gasification plant capable of producing gas from low-grade coal, at a new works at Westfield, near Kinglassie in Fifeshire. The work of cleaning the 48-acre site and preparing the foundations for the plant commenced during the summer of 1958, and at the invitation of the Scottish Gas Board, we recently visited Westfield to see the extent of the progress of work to date.

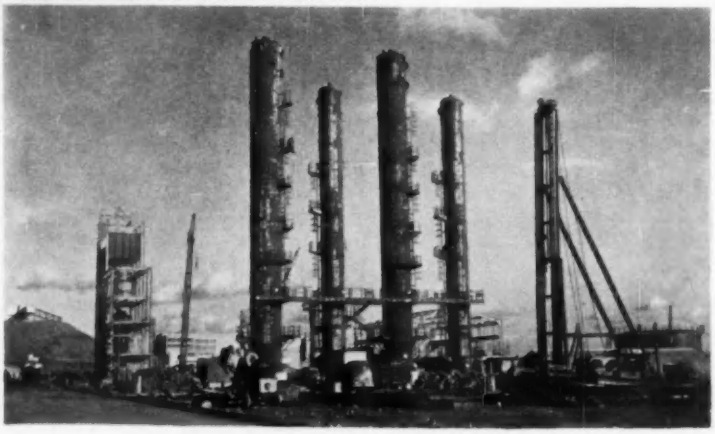
The primary object in deciding to construct the works at Westfield was to produce large quantities of town gas, from an otherwise unsuitable raw material, more cheaply than can be done by conventional methods and means of production. Most of the gas made in Scotland today is, of course, produced by the process of carbonisation, in which coal is "baked" in the absence of air. Volatiles such as tar, benzol and a gas rich in methane are liberated, while there is a residue of coke, which consists mostly of fixed carbon and ash. The new Lurgi plant at Westfield will make gas by the process of complete gasification, a process in which gas is made by the reaction with coal, of steam and oxygen under high pressure. All the carbon in the original coal is converted into gas—there is no coke, and the residue is purely ash. The Lurgi process was originated in Germany, and developed for industrial application for the Lurgi Gesellschaft fur Warmetechnik M.B.H., Frankfurt-on-Main. Various installations have been commissioned in Germany and elsewhere during the past eighteen years—an outstanding example being that at Morwell, Victoria, Australia, which was completed some three years ago. At Morwell, approximately one-third of the heat units in Lurgi gas are converted to liquid fuel, and two-thirds into the form of rich gas for town distribution.

In the new Westfield works, it is proposed to take the low-grade coal by a belt-conveyor system directly from the washery of an adjacent opencast working of the National Coal Board. This coal, containing up to 25 per cent. ash, and 16 per cent. moisture, is to be completely gasified, leaving only ash to be disposed of in "worked-out" sections of the opencast site. The smaller coal will be diverted to a boiler plant used to provide the large quantities of steam required in the Lurgi process.

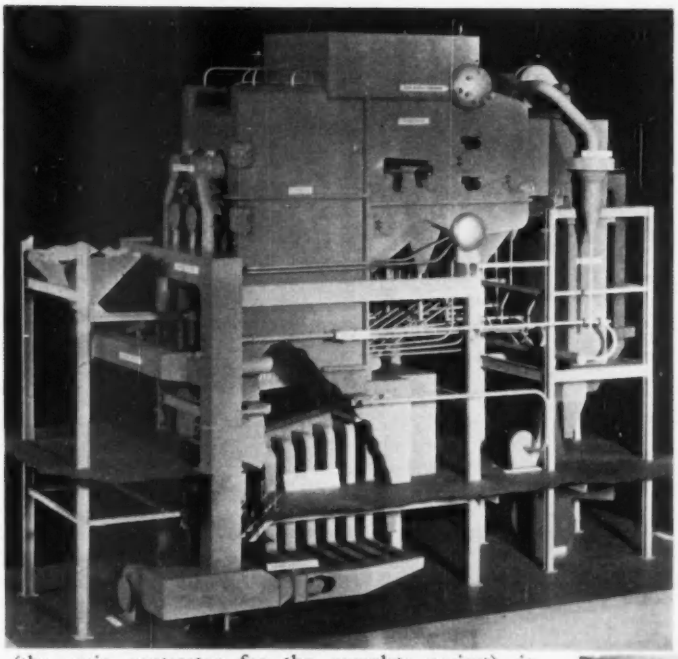
The new plant, the initial cost of which will be about £6,600,000, will have an output of 15-million cu. ft. of gas per day, and will take approximately 266,000 tons of coal per annum. The first stage of the project is expected to be in operation by autumn 1960—with actual gas-making, by the beginning of 1961.

The first gasifier arrived at the site during September last. Initially, three gasifiers will be installed; two will work together on completion of the first-stage of construction. These gasifiers are being provided under an agreement made between Humphreys & Glasgow Limited

(Above). Site of the high-pressure gasification plant at Westfield in Fifeshire. This plant is expected to be producing 15 million cu. ft. of gas a day from low-grade coal by early 1961. A second stage, due for completion in September, 1962, will double production.



(Right). The four towers (regenerators) for use in the Benfield purification process.



(Left). Sectional model of a Bi-drum industrial boiler fitted with a Babcock & Wilcox Ignafluid stoker for burning small coal or coke breeze dust.

(the main contractor for the complete project), in association with the Power Gas Corporation Limited, and the firm of Lurgi of Frankfurt. The gas produced in the Lurgi gasifiers will have a heating value of just over 400 B.Th.U./cu. ft., and in the first stage will be enriched to 450 B.Th.U. by the addition of butane, to be obtained from the nearby Grangemouth refinery.

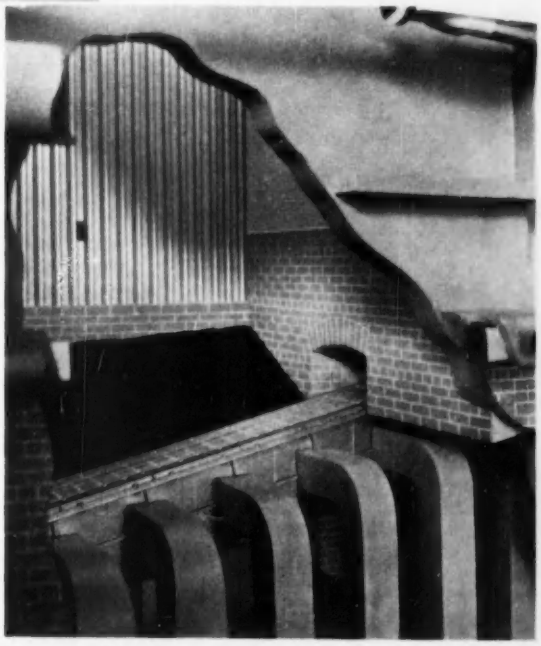
The first three gasifiers are being supplied from Germany, but those supplied under the subsequent developments will be manufactured entirely in Britain. Each of these welded pressure-vessels is 9-ft. 10-in. dia., 28-ft. long, and weighs some 50-tons. They are designed for a working pressure of about 25 atmospheres (360 lb./sq. in.), and when in full production, each will require 240 tons of coal, 60-tons of oxygen and 220 tons of steam daily, to produce some 7½-million cu. ft. per day of purified gas. In a second stage of development of the plant, coal consumption will increase to 400,000 tons, and in a third-stage to 600,000 tons per annum, when the gas output will be approximately 30 million cu. ft. per day.

The adjacent opencast coal workings have a potential output of 600,000 tons of coal a year, and at this rate, their productive life will be twenty to twenty-five years. When no further coal is available at the site workings, low-grade small coal will be supplied from other mines in Scotland.

The oxygen plant

As the Lurgi pressure-gasification process makes gas by reacting low-grade coal with oxygen and steam under pressure, an essential part of the process is, therefore, the production, in bulk, of oxygen. At Westfield, the oxygen is to be provided by the Tonnox system which is an entirely new feature in British gasworks practice. The oxygen plant, which is being supplied by British Oxygen Linde Limited, will produce 200 tons of oxygen per day, and incorporates means of drawing-off and storing oxygen in liquid form. The storage capacity for 550 tons of oxygen will enable full gas production to be maintained for an appreciable time when the oxygen plant has to be stopped to allow for any maintenance work to be carried out. The advantage of the Tonnox system is that a comparatively large amount of oxygen can be drawn-off for storage in liquid form when necessary, and the actual proportion available in such form can be varied within wide limits.

(Below). Close-up detailed view of the Babcock Ignafluid stoker, of the type to be fitted to the 45,000 lb./hr. boilers at Westfield.



Steam-raising plant

For steam supply purposes, Babcock and Wilcox Limited is supplying two 45,000 lb./hr. bi-drum industrial type boilers which are equipped with Babcock "Ignafluid" stokers. Steam conditions at the boiler outlet will be 450 lb./sq. in., and 680 deg. F. This will be the first application in Great Britain of this method of burning small coal for the efficient and smokeless firing of industrial boiler plant. With this method, fine coal is

fed by vibratory feeder or other means on to a fuel-bed that is maintained in a " fluidised " condition (the effect being that of a " boiling " liquid) by pulsated air streams injected below the grate. Combustion of the fines takes place under efficient turbulent conditions within this fluidised fuel-bed, the chain-grate serving merely as a slag-remover. The narrow grate travels between sloping banks of fuel which maintain the correct shape of fluidised fuel-bed, protect the furnace walls, and provide a continuous source of combustible gas which burns above the fuel-bed in combination with the secondary air. An illustration of a model of one of the boilers, with its Ignafluid stoker designed to utilise the low-grade fuel available, is shown in one of the accompanying illustrations.

Benfield plant

After leaving the Lurgi generators, the gas will be cooled, crude benzole will be recovered from it for sale, and the gas will then pass to the Benfield plant for the removal of two unwanted constituents—carbon dioxide and hydrogen sulphide—which will be washed out. The Benfield plant will be visually one of the most striking parts of the Westfield project—consisting of four steel towers (regenerators), two of which are 95-ft. high and weighing 93-tons each, and the other two 110-ft. high and weighing 57-tons each. The difference in weight is accounted for by the differing plate thickness. Two of the towers already in position were fabricated by Babcock & Wilcox Limited, and two by G. A. Harvey & Co. (London) Ltd. Each tower was transported by road in two halves, and welded on site. Only slightly less spectacular are the two smaller dia. 42-ft. towers of the benzole absorber plant.

Purification plant

A new type of tower purifier installation being used for the first time in Britain is another important feature of the Westfield plant. The purifiers, which will have a capacity of 30 million cu. ft. of gas per day, are being supplied by Newton Chambers & Co. Ltd., Sheffield. The purifiers are of the Bischoff type for high-pressure operation, the system being designed to allow for the elimination of the large number of valves usually associated with oxide purification systems, while the oxide handling is fully mechanised to reduce labour requirements. Any remaining traces of hydrogen sulphide will be removed from the gas in these high-pressure tower purifiers, and the gas will then be ready for distribution.

The pipeline which will carry the gas from Westfield to local grid systems around Glasgow in the west, and to Perth and Dundee in the north, is designed for a maximum working pressure of 300 lb./sq. in. The total length of 12-in. steel pipeline to be laid from Westfield to Coatbridge in the west and Dundee in the north is 75 miles. A further 58 miles of steel branch lines ranging from 8-in. to 3-in. dia. will supply individual undertakings and local grid systems. The overall mileage of the Central Scotland Gas Grid to be laid in association with the new plant over the next four years is therefore of the order of 133 miles, which is by far the most comprehensive grid system project ever undertaken by the gas industry in Scotland.

The pipes themselves, which are made in lengths of 25 to 45-ft., are of seamless solid-drawn steel, protected on the outside with woven glass reinforced bitumen asbestos sheathing, and coated on the inside with red lead paint. They are being manufactured by Stewarts & Lloyds Limited.

Power plant

Bruce Peebles and Co. Ltd., Edinburgh, are supplying a large number of electric motors for the Westfield Lurgi high-pressure plant. Outstanding amongst these are two machines of 1,800 h.p., two of 1,450 h.p. and one of 950 h.p., all for driving compressors. Control panels for these motors are also being installed by the company. The 1,450 h.p. and 950 h.p. motors are of the synchronous induction type, which means that in addition to providing power, they will also be used for power factor correction to make for all-round economical operation. In addition to this high-power plant, Bruce Peebles are supplying over 100 smaller motors ranging from 1 to 225 h.p. for driving pumps, conveyors, compressors, fans and boosters. Most of these motors are of conventional design with added protection, where necessary, against weather and corrosive atmospheres.

The illustration, which we include, of the site, was taken at the time of our recent visit, and before the gasifiers were installed; but the structural steelwork of the gasifier building can be seen in front of one of the 110-ft. high Benfield plant towers. On the left, in front of the towers, can be seen the two benzole absorber towers. A lock gas holder, under construction, can also be seen (on the right of the illustration), and in front of it are the foundations for an effluent tank.

PRESENT-DAY FEEDWATER TREATMENT

(*Continued from page 371*)

Various methods of protecting boiler drums and tubes from corrosion after fabrication and during erection have been used, but the degree of success achieved seems to vary, and there is need for an acceptable standard method proved by tests. This would no doubt reduce the demand for acid cleaning and might eliminate it.

Acid dissolves some of the corrosion products and loosens the rest so that a good deal of debris is left in headers and must be removed by hosing or vacuum. After the alkaline " boil out " the metal surfaces are usually left in a shiny-black clean-looking condition, which is quite impressive to see but difficult to evaluate in terms of reduced risk of failure during work. In the author's opinion there is little or no evidence that failure to acid clean has led to failure of tubes, except, perhaps, in the case of the tubes surrounding a cyclone burner. These are small and, being the walls of a cylinder, are quite impossible to clean any other way. They may also from time to time be exposed to high heat input. There must be many high-pressure boilers which have been put to work after the usual several " boil-outs " with sodium phosphate, and heavy blowdown for the first week or two of work. On no account should acid cleaning of high-pressure boilers be undertaken by inexperienced people. There is also an effluent problem in disposing of acid and alkali.

Mr. R. E. Burnett, M.A. (Oxon.), A.M.I.E.E., A.Inst.P., general manager, Marconi Instruments Limited, has been elected to the board, and appointed managing director of the company. Mr. Burnett was appointed general manager of Marconi Instruments in 1956, having previously occupied the position of deputy general manager.

Australian Fuels and their Utilisation

BY OUR AUSTRALIAN CORRESPONDENT

AUSTRALIA, like Britain, now faces a situation in the coal industry where increased efficiency of mining, coupled with competition from other fuels, has caused production capacity to outstrip demand. So far, the situation in Australia is less critical than in Britain, but already the Federal Government has established a committee of experts to look into the possibilities of research to discover new uses for coal. As was clear from more than one contribution to the Symposium held recently in Newcastle, New South Wales, by the Institute of Fuel, the likely trend of research will be towards studies of slagging methods of burning and gasifying coal, the latter with a view to the production of synthesis gas for making chemicals and liquid fuels.

Gasification of Brown Coal with Hydrogen

Describing their work in the Chemical Engineering Section of C.S.I.R.O.* over the past eight years, T. J. Birch, K. R. Hall, and R. W. Urie dealt with the design features of a practical process for gasifying Yallourn brown coal with hydrogen in a continuously operated fluidised-bed reactor. Their experiments with a reactor having a bed of 3-in. diameter and 3-ft. depth, operating at 500-950 deg. C., 300-600 lb./sq. in., and a coal feed rate of 5-36 lb./hr. indicate that hydrogenation occurs in two stages—the first being very rapid, and yielding predominantly methane and water, while the second, involving the hydrogenation of the residual carbon structure, is a much slower reaction. The investigation was undertaken to explore the possibilities of the hydrogenation of brown coal as a source of methane for enrichment of low-calorific-value gas such as is obtained in the full-scale Lurgi complete-gasification plant at Morwell, Victoria. From their experiments, the authors concluded that optimum conditions and performance would be secured with a reactor in which the coal was introduced near the bottom of a short upper-section where the first stage hydrogenation reactions would be completed. Free circulation of fluidised solids would be allowed in this section, so that the heat of reaction would be readily available for preheating the incoming coal. Residual char would then pass downwards through the intermediate section, which would be provided with grid baffles, to enable the bed temperature to be raised progressively towards the bottom. In the final lower section, free circulation of solids would again be allowed, so that the heat of reaction could be made available for preheating incoming gas to the high temperature desired at this part of the bed. Desirable temperatures in the reaction system would be:—upper section, 750-800 deg. C.; intermediate section, 800-950 deg. C.; lower section, 950 deg. C. Work on the experimental reactor is continuing. Its design is being modified in accordance with the above conclusions, and its depth increased to 20-ft.

*Commonwealth Scientific and Industrial Research Organisation (Coal Research Section).

High-pressure devolatilisation of Greta seam coal

I. McColl Stewart made an interesting survey of the possibilities of obtaining liquid fuel from the high calorific-value/high-volatile Greta seam coal of New South Wales. Low-temperature fluidised carbonisation, with power generation from the char produced in the process, has attractive possibilities. However, high-pressure processes offer the advantages of high unit output, easy gas purification, and saving of compressor power for transmission of the gas over a public supply system. The process would have to produce high-C.V. gas or good-quality tar at a cost comparable with heavy-oil costs. Calculations based on Dent's work suggest that a process comprising distillation of Greta coal under pressure at a rising temperature, and in an atmosphere at least as rich in hydrogen as the distillation products being evolved, would give hydrogen and methane in equilibrium proportions. Being moderately exothermal, the reaction would be self-sustaining in either a producer-type or a fluidised bed. The results of this theoretical study are sufficiently promising to stimulate intensive investigation of this possible new outlet for a New South Wales coal.

Selection and use of coal for power generation

A review of this subject in relation to New South Wales over the period 1952-58, presented by Dr. C. R. Kent, revealed that the Electricity Commission is responsible for some 95 per cent. of the coal consumption for power production in the State, and that this amounts to over one-fifth of the coal production. Total coal received by the Commission has risen from 2,671,000-tons in 1952 to 3,541,000-tons in 1958—the main sources of supply being the Commission's own mines (1,019,800-tons) and private mines (1,814,000-tons). As regards seam sources of coal, during the period under review the Great Northern seam has grown in importance; the contribution from the Western Coalfield (mainly Lithgow seam) has fluctuated considerably; there has been a rapid increase in rate of supply from the low-grade coals of the Wongawilli, Tongarra, and American Creek seams; an increase in supplies from the Bulli seam (Burragorang Valley); significant proportions have been received from the East Maitland Tomago Stage coals (mainly Big Ben seam); and there has been a marked decline (from 288,000 to 130,700-tons) in receipts of Greta seam coal from the Cessnock district. Fuel continues to be the major item of cost of electricity generation, and it is one in which further economy is possible. The most significant present and potential factor in reducing fuel costs is the establishment and operation of new power stations in the coalfields.

In general, qualities of coal supplies have improved, but this effect is masked by the preferential use of economically-priced low-grade coals in the newer power stations. In planning output over the year, regard must be paid to the progressively increasing winter peak; and to the

increase in hydro-electric power generation, which coincides at its maximum in springtime with the period of maximum coal output. The proportion of coal burned in pulverised-fuel and spreader-stoker-fired boilers has increased from 33 to 73 per cent., while that of coal used in chain-grate and underfeed stokers has decreased from 67 to 27 per cent. During the past seven years the Commission, with a limited freedom of selection, has increased its intake of coal from economically efficient producers, and has, by its encouragement and custom, assisted these producers to increase their efficiencies. The success of the Commission's activities in this field has been due in large measure to its careful selection of coals, based on sampling, moisture standards, calculation of dry ash-free calorific values, and the enforcement of limiting conditions which must be observed in regard to the acceptability of coals for the Commission's power stations.

Solid fuel versus oil for steam raising

On behalf of the Australian Coal Association (Research) Limited, K. H. Sullivan gave capital costs and annual operating costs for a range of types and sizes of boilers in New South Wales, using various fuels. These data showed that for boiler ratings above 3,500 lb./hr., annual operating costs for coal become more favourable as the size of the plant and the load factor increase. For example, running costs for a 2,940 lb./hr. plant on a five-day week, two-shift basis, would be £A6,990 with a stoker-fired (coal) boiler and £A8,210 with a heavy fuel-oil fired boiler. For a 10,000 lb./hr. unit and the same conditions of operation, the figures would be: stoker-fired coal burning boiler, £A14,670; heavy fuel-oil burning boiler, £A22,545. However, with continuous operation the comparison would be even more favourable to coal:—coal-fired 10,000 lb./hr. capacity water-tube boiler fitted with automatic combustion control, £A30,380; oil-fired, £A49,915.

Spreader stokers

S. L. Shirtley and W. L. Espin dealt with the principles of spreader-stoker firing, and also with certain limitations in the selection of fuels for this type of firing, including high moisture and/or ash content. During recent years, spreader-stokers have been developed to be suitable for the types of solid fuels encountered in Australia (Leigh Creek, brown coal, bituminous coals from New South Wales and Queensland, and refuse fuels). The paper described operating experience with these stokers, and briefly indicated the probable future trends in design. G. K. Cranny dealt in some detail with the technical problems involved in burning fine, high-ash coals in spreader-stoker-fired boilers, making special reference to two new boilers at the Bulimba power station, Brisbane. Close pitching of overfire air-jets located above the coal feeder spreaders appears to be the most beneficial means of reducing carryover of unburnt grits from the furnace. To ensure more rapid combustion of these grits and of coal fines, furnace temperatures should be kept high. Grit reinjection systems for high-ash slack coals should aim at securing the maximum possible dispersion of the grits in the furnace. Coarse grit-arresting equipment should be located as near as possible to the furnace so as to minimise possible erosion of heating surfaces. Total grit reinjection has apparent advantages in respect of increased thermal efficiency, and reduction in dust-handling equipment, but it increases the probability of erosion and unacceptable dust emission.

Power generation using S. Australian sub-bituminous coal

L. J. C. Wigan and J. C. Thomas reviewed progress in the development of the Leigh Creek coal deposits, which are located some 320 miles north of Adelaide, and cover an area of about 12 square miles. The coal contains about 31 per cent. moisture, 22 per cent. volatile matter, 30 per cent. fixed carbon, and 17 per cent. ash. Phosphorus and chlorine contents are at a relatively high level, and calorific value is of the order of 6,000 B.Th.U./lb. The Leigh Creek field has already produced 5 million tons of coal, and it is planned to obtain 60 million tons by open-cut methods over the next 30 years. Production began in 1944, the impetus to develop local coal deposits being provided by the shortage of N.S.W. bituminous coal. Experimental work at the Osborne power stations led to the development of methods whereby the low-grade coal from Leigh Creek could be utilised in existing stoker-fired boilers, albeit at low efficiency. Later, five spreader-stoker-fired boilers installed at Osborne inaugurated the efficient and reliable use of this coal for power generation. The new generating station at Port Augusta, 170 miles from the coalfield, relies entirely on Leigh Creek coal. This 90-MW "A" station, completed in 1957, is now generating nearly half of the electrical-energy requirements of the South Australian State system. The 240-MW "B" station will begin operation in 1960, and will be fully commissioned by 1964. Pulverised-fuel-fired boilers have been adopted for both stations. The main operating problems with Leigh Creek coal have been associated with the ash, both as clinker in the furnace, and fly-ash in the outlet gases. A 260-ft. high chimney is being constructed to secure dispersal of the fly-ash over an area remote from population centres. Water-lancing at regular intervals has been found to deal satisfactorily with furnace ash formations. By developing the production and use of Leigh Creek coal, it has proved possible to free S. Australia from complete dependence on fuels from external sources. The combined output of the two generating stations at Port Augusta is expected to meet the bulk of South Australian State system energy requirements for several years after 1961.

Boiler deposits

A paper by N.Y. Kirov, B.Sc., M.Sc. (Hon. Secretary and Vice-Chairman of the Australian Membership, Institute of Fuel), on the fouling and deposit-forming tendencies of Australian coals, presented analytical data on eleven fireside deposits from stoker-fired boilers at power stations of the N.S.W. Electricity Commission, and three from those of the Electricity Trust of S. Australia. These and other data obtained in a preliminary survey indicated that the bituminous coals of New South Wales and Queensland have a tendency to produce sintered fly-ash deposits, and deposits bonded by phosphate or boron-phosphate compounds, whereas the low-rank coals of S. Australia and Victoria are generally associated with sulphatic bonded deposits of the alkali-matrix type. The author discussed the ash fusibility of

brown and bituminous coals in relation to deposit formation in pulverised-fuel-fired boilers, and outlined the generally accepted methods of alleviating deposit troubles. The lack of sufficient data on the nature and distribution of the mineral constituents in Australian coals hampers assessment of the severity of the fouling problem, and therefore samples should be taken of the deposits which are causing trouble and a study made of their chemical composition and physical characteristics. Research should then be undertaken with a view to correlating the known deposit troubles with the occurrence of specific impurities in certain coals.

In the discussion, there was general support for the author's views, particularly with regard to the need for a systematic investigation of the nature of fireside deposits. Arising out of a suggestion at the Symposium, the Committee of the Australian Membership has agreed to consider the setting-up of a special Committee which will co-ordinate research efforts on this problem in Australia, and disseminate information.

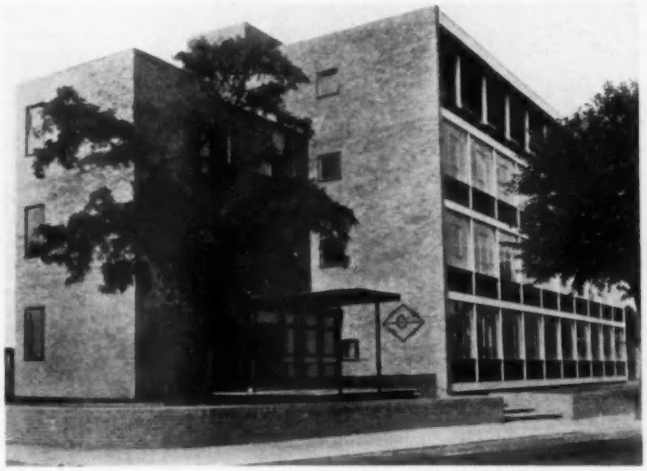
Cambridge Instrument Co.'s New Laboratories

THE Cambridge Instrument Co. Ltd. celebrated the 75th anniversary of its formation in 1956, and in the ENGINEERING & BOILER HOUSE REVIEW issue for June of that year was published a comprehensive history of the company. The story was one of steady progress from modest beginnings in a small workshop intimately in contact with the University of Cambridge, to a world-wide organisation serving industry and laboratory alike. This progress was further emphasised when we were recently invited to visit the company's new research laboratories, which were officially opened on October 14th, 1959, by The Rt. Hon. The Lord Adrian, O.M., M.A., M.D., F.R.C.P., F.R.S.

The new laboratory is situated adjacent to the company's works in Chesterton Road, Cambridge—premises designed specially for the company, in 1895, by the late Sir Horace Darwin, F.R.S., who founded the firm originally in association with Mr. A. G. Dew-Smith. The building which houses the new facilities has a floor area of approximately 20,000 sq. ft., and comprises a four-storey laboratory block, to the left of which is a three-storey entrance block. The four floors of the main laboratory block are approximately 100-ft. long and 40-ft. wide. Each floor has been arranged to serve a separate function, and the experimental or working area of each is laid out on an "open vista" plan.

On the ground floor is the mechanical engineering laboratory, with offices, stores, and a constant temperature room. Under the windows at the front wall of this laboratory are a row of instrument-makers' benches and experimental benches, whilst the remainder of the floor space is laid out with precision machinery and mechanical laboratory equipment. The first floor is devoted to physics and electronics, with a large main laboratory, offices, dark room and optical laboratory, standards room, and an electronic workshop. Near the main staircase on this floor is the research library. The second floor in this block is the physical chemistry laboratory with associated rooms for preparation, balances, and glass-blowing. Both of these rooms have special arrangements for chemical drainage using polythene and vulcathene fittings. The top floor is the design and drawing office, where an important feature is the lighting arrangements. Both front and rear walls have windows along their entire length and glass block daylight ceiling lighting has been incorporated along the centre line of the drawing office. This is supplemented by fluorescent strip lighting covering the whole of the area.

The necessary services—gas, electricity, air, and water—for each of the first three floors are distributed in ducts, while on the ground floor, where the machines of the mechanical engineering laboratory are laid out along the centre line, they are taken through ducts in the ground floor slab. On the first and second floors the benches of the physics/electronics laboratory and the physical chemistry laboratory respectively are laid out in a peninsular arrangement, the benches being positioned against the windows on either side of the laboratories and at right angles to the window line. All the services reach the benches along horizontal ducts under the windows. These ducts have removable facing panels allowing easy access to the pipes for maintenance. All the windows are double-glazed to reduce heat and sound transference. Primary heating is by coils embedded in the structure with additional heating on the staircases and in offices by means of skirting and strip heaters and radiators. Behind the main laboratory is a link block providing access to the existing factory buildings and having a second staircase to all floors. The proximity of the main factory buildings has permitted the installation of ancillary equipment and a boiler plant in the basement of an adjoining workshop.

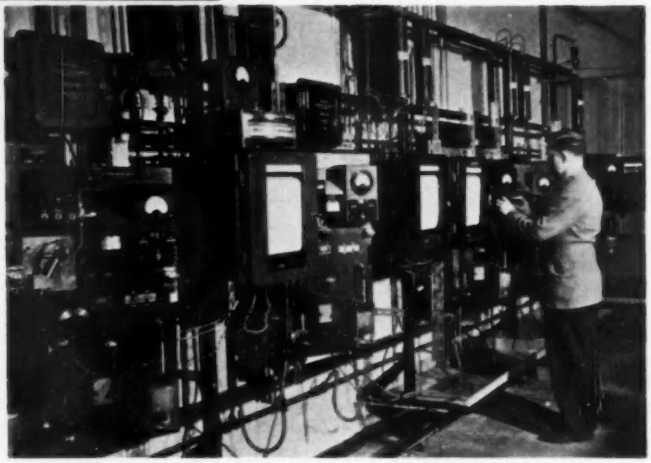


Exterior of the new research laboratories of The Cambridge Instrument Co. Ltd.

At the time of the official opening the

(Left). Part of the physical/chemistry laboratory. At the time of the official opening a series of experiments were being undertaken here in connection with boiler feedwater apparatus, including the determination of dissolved oxygen by electrochemical techniques.

(Below). An electrochemical dissolved oxygen analyser on test at the company's works.



opportunity was given to see instruments in the course of manufacture and under test, and also various projects in the course of development. In the physics/electronic section, for example, was a selection of mechanical thermometers and controllers, from the company's Mechanical Thermometry Division, at North Finchley, including an automatic control panel for a boiler installation, a thermograph programme controller, a demonstration version of the "Numalec" control system, and a display of thermometers, thermographs, and draught gauges. A series of experiments were being undertaken in the physical chemistry section concerned with boiler feedwater apparatus including the determination of dissolved oxygen by electrochemical techniques, a hydrazine recorder, the continuous titration of oxygen, conductivity, dissolved carbon dioxide, and the measurement of pH.

New Heat Transfer Medium

"Thermex" heat transfer medium has been added to the range of phenol derivatives made by the Heavy Organic Chemicals Division of I.C.I. "Thermex" (trade mark of Imperial Chemical Industries Limited) is a eutectic mixture of diphenyl oxide and diphenyl in the respective proportions by weight of 73.5 per cent. and 26.5 per cent. It is the first heat transfer medium of this type to be manufactured commercially in Britain. A highly desirable combination of physical properties makes "Thermex" particularly suitable for liquid-phase and vapour-phase heating and cooling in a variety of industrial processes. It has a high boiling point (255 deg. C.) and low freezing point (12 deg. C.), and excellent thermal stability over long periods at temperatures up to 400 deg. C. It has high heat transfer coefficient, particularly in the vapour phase; further, it is non-corrosive and presents a negligible fire risk. At high temperatures, "Thermex" operates at low working pressures. For instance, at 250 deg. C., when steam is at a gauge pressure of 565 lb./sq. in., "Thermex" is still in the liquid phase and at atmospheric pressure. At 350 deg. C., the gauge pressure of steam is 2,385 lb./sq. in., whilst the comparable pressure of "Thermex" is only 80 lb./sq. in. Furthermore, in vapour-phase heating, very accurate temperature control may be achieved simply by regulating the pressure. A single "Thermex" boiler may be used simultaneously for several different consuming points by adjusting the pressure at each point to give the desired temperature. Typical examples of industrial processes in which "Thermex" can be used are: the melting and spinning of synthetic fibres; the distillation and processing of fats, vegetable oils, petroleum fractions, and other high-boiling products; the concentration of sulphuric acid and caustic soda solutions; the processing of plastics and rubber products by extrusion and moulding techniques; and the manufacture of paints and varnishes.

Associated Electrical Industries Export Limited has received an order of more than £400,000 in value from Basrah Petroleum Co. Ltd. for the provision of additional generating equipment at Fao, in the Arabian Gulf. The order placed with A.E.I. covers the necessary power plant, switchgear and interconnecting cables. The power plant will comprise three gas-turbine-generator sets, each of 2,250-kW nominal rating and including an L.21 axial-flow gas-turbine driving an a.c. generator through single-reduction gearing. Manufacture will be mainly at the A.E.I. Turbine-Generator Division's Trafford Park Works, but some portions will be made at the Germiston, Glasgow Works of the Division. The first generating set is due for completion of manufacture in 15 months, and the three sets will be delivered within 22 months. Other A.E.I. gas turbine-generators being installed overseas for the petroleum industry include a 4,500-kW set in Borneo, and three 4,000-kW sets in Iran, the prime mover for these larger sets being the L.51 gas turbine. A smaller unit of 1,750-kW installed at La Concepcion, Venezuela, has now completed over 20,000 hours of base-load service.

* * *

The Department of Scientific and Industrial Research announces that with the appointment of Lord Hailsham as the Minister with general responsibility for science and technology, including atomic energy, the Atomic Energy Office and the Lord President's Office will be combined. The new office will be in the charge of **Mr. F. F. Turnbull,** whose appointment as deputy-secretary, to succeed Sir Friston How in charge of the Atomic Energy Office, was announced some months ago. It will be organised in two divisions: (1) a general division, under **Mr. R. N. Quirk,** under-secretary, corresponding to the previous Lord President's Office; and (2) an atomic energy division, under **Mr. M. I. Michaels,** under-secretary corresponding to the previous Atomic Energy Office.

N.I.F.E.S.—Fifth Annual Progress Survey

AT the fifth annual general meeting of the National Industrial Fuel Efficiency Service, held in London on September 17th, 1959, Sir Leslie Hollinghurst, G.B.E., K.C.B., D.F.C., chairman, in his official statement expressed regret that it had not been possible to complete the printing of the Progress Survey for the year ending March 31st, 1959. The Survey has now been made available, and the information it contains elaborates the many important points made by Sir Leslie; all of which provided evidence of the expansion of the work carried out by N.I.F.E.S., and its value to the national economy.

The year under review shows a marked advance in every category of N.I.F.E.S. engineering services to British industry, except one. The single reverse was in the number of boiler operators undertaking training for the City and Guilds Boiler Operator's Certificate. In the main activities, however, the overall increase exceeds 20 per cent. These activities, as will be well-known, include: Heat and Power Surveys to provide accurate measurement of plant efficiency; Regular Service Agreements to secure and maintain the highest level of day-to-day plant operation; and a Specific Advisory Service to provide specialist advice and solve individual problems. The statement of accounts included with the Survey shows that earnings from fees during the year under review amounted to £145,704, as against a figure of £116,132 for the previous year. As a non-profit making organisation, serving industry generally, N.I.F.E.S. is sponsored by the National Coal Board, the Gas Council, the Electricity Council and the South of Scotland Electricity Board, together with Shell-Mex & B.P. Limited, Esso Petroleum Co. Ltd., and the Government of Northern Ireland. From these sources, N.I.F.E.S. received a total of £436,066 during the year.

Improving boiler efficiency

A section of the Survey dealing with "Improving Boiler Efficiency" is, perhaps, of particular interest. Here it can be seen that altogether over 1,900 boilers of different types have been subjected to full efficiency tests by the organisation's engineers. This is in the order of one in twenty of the boilers in daily use in this country, and represents an annual fuel consumption exceeding 3-million tons of coal or its equivalent in fuel oil. The conclusions drawn from these tests are that, "unless an industrialist has the strong evidence of a recent test to the contrary, it is an even chance that he is wasting one ton in every eight he purchases, a loss of about £1,000 a year if the plant consumption is 30-tons a week." Methods of improvement are classified broadly under three headings: correcting errors in operation; catching up with delayed maintenance; and the installation of new equipment.

The frequency with which recommendations are made in these categories are given, with reference to the 402 heat and power surveys of shell-type boilers carried out during the year 1958/59. Of these, 358 were coal-fired and the remaining 62, oil-fired; the actual number being made up of 245 Lancashire, 107 Economic and 66 Vertical boilers. Altogether, over 800 recommendations were made for improving efficiency, and of this total 236 were directed to securing better operation by either the training of stokers; prevention of the emission of smoke; the use of exhaust steam from feedpumps; the better use of economisers; and the reduction of grate area to achieve better combustion conditions. Of the 202 cases for which improved maintenance was suggested, the most frequent needs were for the repair of insulation and the prevention of air infiltration, while other recommendations covered a variety of faults including the adjustment of mechanical stokers; the prevention of steam leaks or safety-valves blowing; the repair of dampers; and the replacement of firebars or furnace doors. N.I.F.E.S. are often asked to undertake a survey to establish whether an existing plant can support an increase in production, or whether a more modern boiler would be necessary. This is put forward as the reason for the high number (sixty-two) of recommendations for new boiler plant. New equipment was actually suggested in some 295 cases, other items being mechanical stokers, instrumentation, and feedwater economisers.

It has been estimated, following the surveys of the 420 boilers, that fuel to the equivalent of 98,000 tons of coal, 13.2 per cent. of the total consumption, could be saved. The cost of new equipment recommended totals £500,000 and on the overall figures this would be repaid in fuel savings within eighteen months. A number of case-histories are published to show how fuel is being burnt more economically in industrial boiler plants as a result of a programme of modernisation and operational improvement carried out consistently over a period of years.

Apart from work in connection with the boiler plant itself, N.I.F.E.S. activities extend within the factory, where it is now generally accepted that there are greater savings of energy to be made. In this field, unexpected dividends have resulted, as, for example, increased output from plant; better working conditions and productivity; and improved quality of products. In this section of the Survey also, examples are included in the form of case-histories.

The Clean Air Act

The Clean Air Act came into force during the year, and although, as previously stated, fewer boiler operators have come forward for training than was expected, the calls in other directions on N.I.F.E.S. services have increased as a result of the Act. During the year several hundred firms have asked for advice on smoke and grit emission problems. The provisions of the Act for prior approval of new equipment are of obvious value to the industrialist, but such applications have to be considered with great care, and an expert technical appraisal of the application is virtually indispensable. N.I.F.E.S. have, therefore, notified all local authorities of their willingness to advise them, and a number are now employing the organisation to examine applications for prior approval of new equipment. In some areas, adjacent local authorities have formed a joint panel, on which N.I.F.E.S. engineers sit to ensure a consistent policy. A further example of the help offered by N.I.F.E.S. to local authori-

ties in the task of administering the Clean Air Act has been the arranging of refresher courses on combustion practice for public health inspectors. Assistance has also been given to technical colleges in running similar courses.

Dealing with developments in Northern Ireland the Survey states that the number of major fuel users in the country is about 700, and that since the Belfast office of N.I.F.E.S. was opened in 1955, visits have been made to 430 plants. The service has been conducted on similar lines to those found effective in Great Britain, and, in addition, efforts have been made to promote interest in the more efficient operation of plant, by arranging various coarses for engineering management.

In addition to the organisation of lectures, courses, conferences and exhibitions dealing with fuel-efficiency, N.I.F.E.S. are responsible for the distribution of a great deal of literature on the subject. In the early months of 1959, for example, they published a new Stoker's Manual —a complete revision of the manual published for the Fuel Efficiency Committee of the Ministry of Fuel and Power in 1945. The new manual covers developments in the mechanical-firing of shell-type boilers with coal, and includes a new section on oil-firing. Special attention is also given to the provisions of the Clean Air Act, and the prevention of dark smoke.

Neutron Project Starts Work at Harwell

A NEW laboratory came into operation on November 5th at the Atomic Energy Research Establishment, Harwell, which will produce nuclear data of great value for the design of reactors. Extending over a 20-acre field, and housing what is probably the most extensive range of neutron time-of-flight spectrometers in the world, the laboratory is under the supervision of the Nuclear Physics Division of A.E.R.E. and was designed to their requirements. The laboratory is centred on a machine which is, perhaps, best described as a combination of an accelerator and a reactor. An electron linear accelerator is used to generate an intense pulsed beam of electrons, which fall upon a mercury target to produce X-rays, which in turn are directed upon a uranium target to produce neutrons. In this machine, the uranium target is itself a sub-critical fast reactor. Without the electrons the reactor is effectively shut down and generates no neutrons. During the pulse, however, the neutrons produced from the electrons stimulate the reactor which then burns for an instant at the rate of 10-MW and in doing so releases many more neutrons than could have been produced by the electron beam alone. At the end of the pulse the reactor reverts to its quiescent state. Because of the pulsed nature of the machine, its mean nuclear power output is of the order of only 2½-kW. The equipment is intended to provide information about the detailed behaviour of neutrons of known velocities when they encounter the materials employed in the construction of reactors. One of the best methods of determining the velocity of a neutron is by a direct timing technique. Neutrons from a pulsed source are allowed to travel down a number of evacuated tubes (flight-tubes) radiating out from the neutron source. These tubes range in length up to 200 metres (650-ft. approx.) and form a prominent feature of the new laboratory. At the moment of the pulse an electronic " stop-watch " is started, and at the end of the tube a detector transmits a signal when the neutrons arrive and so enables their speeds to be determined. The speeds of the neutrons in which the physicists are interested lie between 500 metres/sec., and 5 million metres/sec., and elaborate electronic apparatus, capable of measuring short times to an accuracy of one-ten-millionth of a second, has been installed. Because of the very long distance the neutrons have to travel, resulting in losses en route, a very intense source of neutrons is required, and the present machine is capable of liberating 100,000 million neutrons in a pulse lasting one-quarter of a microsecond. When a specimen containing nuclei of interest to the experimenter is placed as a target at the far end of a flight tube, neutrons of different energies will strike it consecutively, and information can be obtained on the " reaction " of the neutrons of different energies by making observations at varying times after the pulse has started on its journey. The new equipment should be a particularly flexible tool for research in nuclear physics and reactor physics, and will make possible neutron cross-section measurements of much higher accuracy than have previously been carried out at Harwell. The accelerator used is a travelling wave linear electron accelerator installed by Metropolitan-Vickers Electrical Co. Ltd. It produces an instantaneous beam current of 1/3 amp at an energy of 30 million electron-volts. The sub-critical reactor used as a target was designed and built at A.E.R.E., and uses highly-enriched uranium as fuel. Because of the radiation produced, the whole equipment is enclosed in a special building with concrete walls 6 ft. thick. This building is designed to permit the use of a large number of beams of neutrons so that many experiments may be performed simultaneously ; and plans are being made to build a longer (300 metre or 980 ft. approx.) flight tube. Already twelve experiments have been laid out in the area surrounding the building, and scientists from the Commonwealth and from the United States have joined the teams assembled to use the equipment.

The United States Atomic Energy Commission and the **United Kingdom Atomic Energy Authority** have signed a five-year agreement to exchange technical information on advanced gas-cooled reactors. This was announced on November 16th by Lord Plowden and John A. McCone, chairmen of the Authority, and the Commission respectively. The exchange will be carried out under the terms of the U.S.-U.K. agreement for co-operation in the civil uses of atomic energy which has been in effect since 1955. Data will be exchanged on development, design, construction and operation, as well as on related research and development, of the advanced gas-cooled reactors being built at Windscale, England, and on the U.S. experimental reactor project of this type at the Oak Ridge (Tennessee) national laboratory. Information exchanged under this agreement will be made available to British and American industry. The agreement was completed during recent discussions in London and Washington by U.S. and U.K. representatives on matters of mutual interest in the civil uses of nuclear energy.

British Launderers' Research Association

IMPROVED laboratory facilities for the work being carried out by the British Launderers' Research Association on the automatic continuous washing machine, and chemical engineering aspects of laundering, have now been provided in an extension recently built at the Association's establishment, Hendon, near London, and which was officially opened by the Mayor of Hendon on November 6th, 1959.

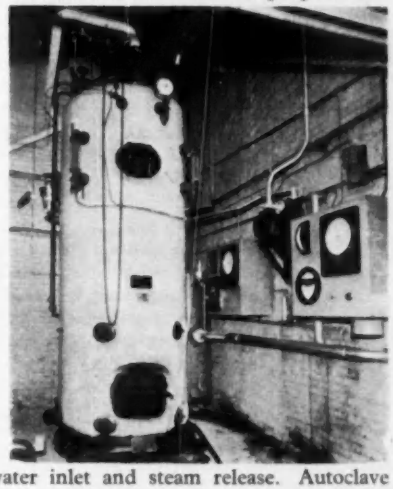
The B.L.R.A. was formed in 1920, and today offers members a most comprehensive service. Some idea of the scope of this service was evident from exhibits arranged in conjunction with the open days held prior to, and following, the official opening. These covered high-temperature washing processes for woollen blankets; washing of nylon and Terylene; optical whites; abrasion testing of textiles; flameproof testing; new fibres and fabrics; ultrasonics; microscope techniques; continuous washing equipment; simplified automatic control process and automatic timing devices.

The steam requirements for an experimental laundry and the laboratories are provided by a De Poray-Redheugh boiler and a "Stone-Vapor" steam generator. These units were available for inspection, being fully-instrumented to furnish complete records, while in addition the De Poray boiler has been arranged for alternative methods of firing—oil, solid fuel by an underfeed stoker, and solid fuel manually.

De Poray vertical water-tube boilers are available in a range covering an m.c.r. of 840 to 6,000 lb./hr., from and at 212 deg. F., with working pressures of 40 to 120 lb./sq. in. The larger size has dimensions of 6-ft. × 19-ft. 2-in., with a water capacity of 820 gal.; being fitted with 208 tubes, providing a heating surface of 882 sq. ft. The boilers, which can be fired by coal, coke, oil or gas, are provided with two furnaces, the first being the primary combustion chamber, and the second an extension to it, known as the diffuser. This is lined with sectional refractories, forming a fire-proof ring which obtains a high temperature by absorbing radiated heat from the primary combustion chamber. All carbons failing to ignite on leaving the primary chamber are met by a secondary air supply. Combustion reactions are accelerated by the high-temperature diffuser chamber, thus increasing the upward velocity of the gases. This ensures complete, and, therefore, smokeless combustion with a minimum of excess air, resulting, the company claim, in a CO_2 content of 14-15 per cent. with oil, and 15-16 per cent. with coal. Gases emerging from the diffuser enter a radiation bell, so designed as to ensure that the gases are returned to circulate over the entire area of the water-tubes. At the same time the bell absorbs heat from the gases, this heat being transferred by radiation to the tubes which are placed around it, thus the temperature of the bell is limited by the proximity of the water-tubes.

Accelerated circulation is obtained through the increased transmission of heat uniformly to the entire surface of the tube-bank, while in addition the tubes are fitted with central circulating tubes which allow cooler water to flow freely downwards without coming into contact with the steam product. This enables the steam bubbles to rise more rapidly, resulting in a high degree of turbulence which sweeps the bottom of the tube with a scouring action, so keeping the inner surface free from scale. The tube ends take the form of a conical section to which the tube-plate corresponds, a design feature which the manufacturers claim enables the tubes to fit tightly without the use of mechanical aids such as expanding or welding.

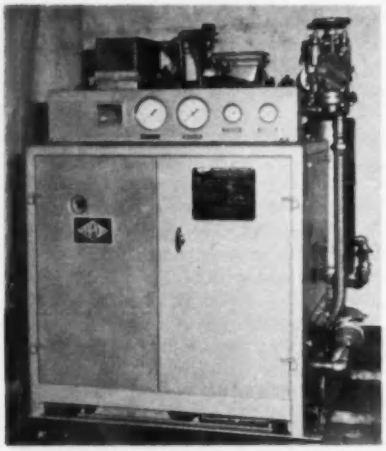
A further advantage claimed for the boiler is that the primary combustion furnace comprises an expansion element, which under working conditions is stated to greatly reduce stress concentration, and to strengthen the inner section. It is also said to provide protection against local overheating of the bottom of the tube-bank, and the whole upper part of the furnace. This protection is achieved by the design of the expansion element, which makes the upper furnace section, housing the radiation bell and tube-banks, virtually a separate chamber in no way subjected to direct radiation. Additional features of this design are the complete cooling of the furnace crown section, to allow for which ample provision is made for water inlet and steam release. Autoclave hand holes are incorporated to allow easy inspection and cleaning of the entire heating surface. Access to the tube bank is provided through the expansion element.



The De Poray-Redheugh boiler installed at the British Launderers' Research Association Establishment at Hendon. The boiler is at the present time arranged for oil-firing.

The "Stone-Vapor" steam generator, supplied by J. Stone & Co. (Deptford) Ltd., is a Model 4616 unit, designed for a m.c.r. of 1,750 lb./hr. at 150 lb./sq. in., with feedwater at 60 deg. F., the equivalent evaporation from and at 212 deg. F. being 2,105 lb./hr. It is an oil-fired forced-circulation, water-tube boiler, and, as with other units from the "Stone-Vapor" range (1,000 to 4,500 lb./hr.), was factory-tested and adjusted before delivery as a complete installation with integral operating instrumentation and safety controls. A single electric motor (or internal combustion engine) drives the water-pump, fuel-pump and F.D. fan. Full output, up to 200-lb. steam pressure, can be developed from a cold start within the space of two minutes, and thereafter

operation is completely automatic. The burner equipment fitted permits modulation down to 25 per cent. evaporation with continuous flame; and down to zero delivery when cycling on and off automatically. Steam with a dryness-fraction of approximately 0.99 is produced by the "Stone-Vapor" generator, this being a further important point in connection with laundry steam requirements, as the manufacturers claim that increased operating speeds with calender rollers are possible, due to the better distribution of this high quality steam.



The Model 4616 "Stone-Vapor" steam generator awaiting installation at Hendon. This unit has a capacity of 2,105 lb./hr., from and at 212 deg. F.

Another exhibit concerned an experimental de-aerator for boiler feedwater. This equipment was manufactured by Caird & Rayner Limited, and has now completed many months of successful operation supplying the boiler plant mentioned above with feedwater deaerated to not more than 0.02 mls/litre of dissolved oxygen. A Wallace & Tiernan Limited dissolved oxygen recorder is used in conjunction with this plant. In operation, the mixture of condensate return and make-up water is led into the top of the de-aerator, from which it falls by gravity through steam, at a slight pressure above atmospheric, to the closed feed storage tank below. The released gases are vented together with a slight wisp of vapour from the vent orifice at the top of the de-aerator. The only operating cost is the small supply of steam at 5 lb./sq. in. led to the casing of the de-aerator to raise the temperature of the condensate/make-up mixture to about 212 deg. F. From the storage tank the de-aerated feedwater passes through a cooler to reduce the water temperature to 170/180 deg. F., before it reaches the boiler feed pump. To obviate the hot feed flashing and causing steam locking at the suction of a reciprocating boiler feed pump, the static head over the pump suction should be at least 15-20-ft. The cold water necessary for cooling the feedwater is passed into the bottom of the cooler and out at the top, some of the warmed water being led via the storage tank float valve for condensate make-up, the remainder of the cooling water, which may be at a temperature in the region of 110 deg. F., could, it is suggested, possibly be usefully employed in some wash water system.

The prevention of steel chimney corrosion and smut emission with oil-fired boilers was the subject of a further exhibit. This matter was dealt with in a paper presented to The Institute of Fuel earlier this year, by H. A. Blum, Dipl. Ing., British Launderers' Research Association, and B. Lees, M.Sc., A.R.I.C., M.Inst.F., and L. K. Rendle, B.Sc., A.M.Inst.F., British Petroleum Co. Ltd. The conclusions drawn from this work were that the emission of smuts from some oil-fired boilers is closely associated with low-temperature corrosion of steel chimneys or other outdoor steel parts of the plant. It was shown that raising the temperature of the metal surfaces above 250 deg. F., by lagging and shielding, will prevent the emission of smuts and reduce corrosion to negligible proportions. This has been achieved by surrounding the chimney with a plain aluminium sheath, leaving a $\frac{1}{4}$-in. radial gap, which reduces the heat loss by conduction, while the bright aluminium surfaces reduce the loss by radiation.

A final exhibit of interest to those responsible for the operation of plant in laundries was staged by Trier Brothers Limited, manufacturers of "Stauffer" greases, lubricants and lubricators. This covered the well-known "Collgraf" lubrication system for steam engines, pumps, etc.—a method of oil-free lubrication—together with a range of "Stauffer" lubricators and "Staufferlube Multigreasers."

A.E.I. REORGANISATION

The names of three well-known companies are to disappear from the British industrial scene. On January 1st next, the British Thomson-Houston Company, Metropolitan-Vickers Electrical Company, and Siemens Edison Swan Limited, are to become respectively—Associated Electrical Industries (Rugby) Limited, Associated Electrical Industries (Manchester) Limited, and Associated Electrical Industries (Woolwich) Limited. The change, together with the reshuffling of a number of the group's subsidiaries to form five new product divisions, virtually completes the major internal reorganisation which has been carried out by the parent company, Associated Electrical Industries Limited, over the past two years. At a press conference on November 23rd, Lord Chandos, the chairman, said that although A.E.I. would be sorry to see the old names go, the change would help the group to compete more effectively with the other big manufacturers of electrical plant and equipment. Employees of the three companies will be asked to agree to the transfer of their employment engagements to the three new A.E.I. firms, but this, Lord Chandos emphasised, is a matter of legal form only. Wages and other conditions of service will remain unaltered. Although the changes are entirely an internal affair—all the companies are wholly-owned subsidiaries—it is obvious that A.E.I. thinks them very important. At the moment, the different divisions sometimes make competing products. This should cease as each new division specialises in one class of product—turbo-generators, switchgear, motors and control gear, cables, and so on. Renaming of the companies should also make A.E.I. better known to the public at large, although Lord Chandos made it clear that trademarks associated with (say) Metro-Vick would not necessarily disappear just because the company had changed its name.

A dollar order valued at approximately £190,000, has been obtained by **A.E.I. (Rugby) Limited** for a large turbine-driven centrifugal blower required for a catalytic cracking plant in the new Duque de Caxias Oil Refinery at Rio de Janeiro. This refinery (which, with an output of 90,000 barrels of oil per day, will be the largest in Brazil), is being engineered and constructed by the Foster Wheeler Corporation, of New York, for Petroleo Brasileiro S.A. (Petrobras). The order for this machine forms part of a contract between Petrobas and Brefcon Limited (a consortium of British manufacturers of petroleum equipment), for the supply of U.K.—manufactured plant. The blower will be a three-stage machine, delivering 110,000 cu. ft. of free air per min. against a discharge pressure of 30 lb./sq. in., and will be driven by an A.E.I. 12,900 b.h.p. condensing turbine supplied with steam at 565 lb./sq. in. and 660 deg. F.

RECENT *Equipment* AND *Accessories*

Chain-grate ash-extractor

An automatic ash-extractor has been developed as a standard fitting for installation with most sizes of either new or existing Riley Type "T" chain-grate stokers made by Riley (I.C.) Products Limited. This extractor is a conveyor so-designed that wear is limited on the moving parts, since the ash is stationary on the apron plates, and moves in relation to the conveyor (not in opposition to it as in the case of scraper and drag-link conveyors). The conveyor, which travels at a constant speed of $3\frac{1}{2}$-in. per minute, is driven by a separate gear assembly comprising a $\frac{1}{2}$ h.p. geared motor with a reduction of 1,440/0.96 r.p.m., and a further gear train with a 3 to 1 reduction, giving a front-shaft speed of 0.32 r.p.m. A spring-loaded clutch with the driven-half on a splined shaft protects the gear assembly from overload, and provision is made for tensioning the conveyor. A steam-cleaning assembly, which, the makers state, is operated for about 15 sec. per week and uses less than 1 lb. of steam in the process, is incorporated to remove any fine particles of ash which penetrate to the inside of the extractor. The ash-box at the front of the stoker provides for the use of an ash-chute to a water-trough conveyor, but it can be fitted with a draw-plate for discharging ash into a low trolley or pan, if required. The use of an automatic ash-extractor, such as this, eliminates the need for frequent opening of ash-doors, and thus prevents the ingress of air which cools the furnace gases and reduces efficiency. Forced-draught fans do not have to be stopped while ashing is in progress, and there is a resultant saving in labour. [*Riley (I.C.) Products Limited*, 19, *Woburn Place*, *London*, *W.C.*1.]

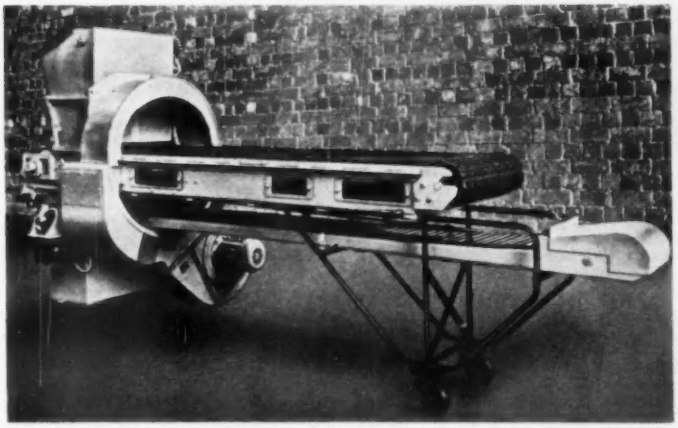


Fig. 1. The new automatic ash-extractor developed for installation with Riley Type "T" chain-grate stokers. [Riley (I.C.) Products Limited.

Automatic boiler temperature controller

A new automatic boiler temperature controller for controlling a heating system so that any desired room temperature is maintained constantly irrespective of changes in weather conditions, is now available from Samson Controls (London) Limited. At present this is being imported from Germany, but the company hope shortly to manufacture the control, under licence, in this country. Incorporated in the unit are two thermostats integrally connected in one system filled with a liquid having a high coefficient of expansion. One thermostat is fixed outside in the open air and the other is connected into the boiler. Both thermostats work in conjunction with one another. Simple controls are provided for setting the desired boiler temperature, and any combination of open air/boiler flow temperatures can be accommodated. A manually-operated switch marked "day" and "night" provides an automatic lowering of the boiler temperature through the night. The capillary tube connecting the outside thermostat to the unit is compensated so that it is unaffected by the temperature of either the boiler room or any other space through which it passes. Two models of the control are available, one to control the automatic burner of an oil-fired boiler and the other, complete with electric motor, connecting chains, etc., to control the settings of the flue and boiler dampers of a solid-fuel burning boiler. [*Samson Controls (London) Limited*, 19, *Borough High Street*, *London*, *S.E.*1.]

Fig. 2. The Samson automatic boiler temperature controller. [Samson Controls (London) Limited.

Motor control unit

At the recent Engineering Industries Association Twelfth Engineering Display the Electrical Remote Control Co. Ltd., exhibited for the first time their motor control type MCU, which has been designed to provide means for automatic reversal of electric motors. The unit can, however, be used for any other application where periodic and alternate operation of two electrical circuits is involved. The control unit closes alternately two electrical circuits for continuously adjustable periods at continuously adjustable intervals with the overall timing cycle (anything between 10 sec. and 30 days) remaining always constant. Three standard variations of the control are available. Pressing of a start button on the unit MCU/A, or pressing of an external start push button connected to terminals of the unit energises an internal timer which closes alternately two electrical circuits (which are usually connected to contactor coils reversing

the motors) with an adjustable interval between alternate closing to allow the motors to come to a standstill. Pressing of the reset push button on the unit or of an external reset push button wired to the terminals of the unit resets the internal timer automatically within half a second even if the overall timing period is one month and, at the same time, the coils of both motor contactors are de-energised. Two indicator lights show if the motor is running in forward or reverse direction, and another light gives indication of voltage supply. Control unit MCU/B energises alternately two motor contactor coils for continuously adjustable periods at continuously adjustable intervals with the overall timing cycle remaining constant, but the unit does not reset to zero position on power failure. Disconnection of the voltage supply stops the unit. Timing action is continued on restoration of input voltage. The unit is provided as standard in an enclosure similar to unit MCU/A with three indicator lights, but without push buttons. Control unit MCU/S gives the same facilities as unit MCU/A. However, not only the individual "on" and "off" periods but also the overall timing period are continuously and independently adjustable. All units can be supplied for the overall timing period between 10 sec. and 30 days. The minimum timed interval which may be pre-set equals approximately 1/60th of the overall timing period. Switching capacity is 6 amp. and 250 volts, a.c., or 110 volts a.c. The units are supplied as standard in 10-G. pressed steel enclosure. Watertight or flameproof enclosures can be provided. (*Electrical Remote Control Co. Ltd., Elremco Works, Harlow New Town, Essex.*)

Reverse-flow multi-cell cyclone dust-collector

A recent addition to the range of dust collection and control plant manufactured by the Gas Cleaning Division of W. C. Holmes & Co. Ltd. is the Type-"UK" reverse-flow Holmes-Rothemuhle multi-cell cyclone dust-collector, which has been designed for those applications where good gas distribution conditions cannot economically be achieved and where large gas volumes are encountered. The collector comprises an assembly of cyclone cells, the number of which is directly proportional to the volume of gas to be cleaned. Each cyclone cell consists of two concentric tubes; an outer dirty gas cylinder with a stationary impeller fixed at the inlet, and an inner clean gas tube which passes up through the centre of the impeller. The outer cylinder is approximately 10-in. dia. except at the base which is conical in shape. The high separating efficiency claimed for the collector is derived from the relatively small diameter of the individual cyclone cells. The individual cells are supported in a sheet steel grid, which is in turn enclosed in a rectangular steel casing, the lower half of which serves as the dust bunker. In the upper half of the casing, known as the top box, the clean gas tubes terminate in a stepped floor, the construction

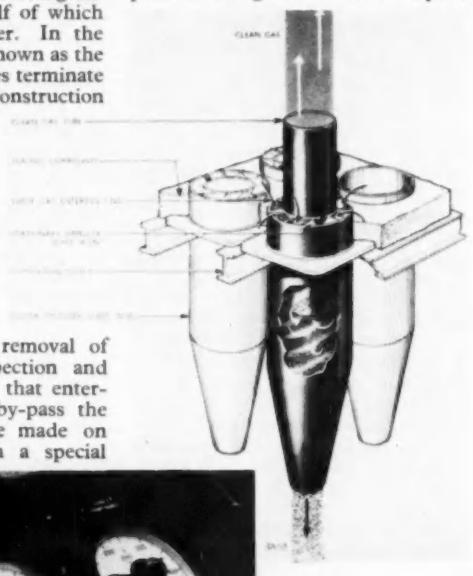


Fig. 3 (right). Artist's cutaway view of the Holmes-Rothemuhle reverse-flow multi-cell cyclone dust-collector. (W. C. Holmes and Co. Ltd.)

of which facilitates the removal of individual cells for inspection and maintenance. To ensure that entering dirty gas does not by-pass the cells, gas tight joints are made on the supporting grid with a special sealing compound. In operation, the impeller imparts an intense swirl to the dust laden gas as it enters the cell causing it to descend with a spiral motion. Near the apex of the conical section of the dirty gas cylinder the axial velocity of the spiralling gas is turned through 180°. The dust-free gas having reversed direction passes up through the clean gas tube to the exhaust fan and stack. The reversal of direction of flow causes the dust to be centrifuged and it is propelled downwards into the dust bunker. (*W. C. Holmes & Co. Ltd., P.O. Box No. B.7, Turnbridge, Huddersfield.*)

Fig. 4 (left). Three "Bikini" temperature-controllers mounted on the sloping face of a control-panel. (Fielden Electronics Limited.)

Transistorised temperature controller

The first of the new Fielden Electronics Limited "Bikini" range of transistorised instruments to be announced is a precision temperature controller, with a differential of only 0.5 deg. C., high calibration accuracy and high long-term stability. The instrument is housed in a small meter-type case and occupies a panel space of only 4½-in. dia. The scale, which is 9-in. long, is calibrated directly in deg. C. or deg. F., the pointer being set to the required control temperature by a small knob in the centre of the instrument. A red light visible from the sides as well as from the front indicates the control action. The meter-type case is completely sealed and contains no delicate moving parts. It can be mounted at any angle; for example, on a sloping control desk. Control can be at any temperature between − 200 deg. C. and + 500 deg. C. with a minimum temperature range span of 50 deg. C., and there are 12 standard calibrations. A platinum resistance element is used at the temperature measuring point, this being housed in a stainless-steel sheath of ¼-in. diameter. The connecting cable between the measuring point and the instrument can be up to 300-ft. in length without introducing errors. The control action is on/off, either electrical or pneumatic. The electrical contacts give change-over switching at 5-amperes,

250-volts, whilst the pneumatic valve requires 17 to 20 lb./sq. in. input. The electrical or pneumatic control relay can be located up to 300-ft. away from the instrument itself and only simple light duty cabling is required between the instrument and the relay. The instrument is completely transistorised and will operate from a 12-volt d.c. supply, the components operating well below their maximum rating. The low voltage and current allow the instruments to be used safely in hazardous areas. Inexpensive power supply units are available to provide the necessary 12-volts d.c. from the usual supply mains. These can be supplied for one or a number of instruments, and can be fitted with or without the electrical control relays. (*Fielden Electronics Limited, Paston Road, Wythenshawe, Manchester* 22.)

Automatic tube expander control unit

The Mk. IV electric automatic torque control unit has been developed by Charles Wicksteed & Co. Ltd., and provides an economic, compact form of automatic precision tube expanding equipment. The range of tubes which can be handled by the Mk. IV is approximately ⅜-in. to 1-in. o.d., but other sizes close to, but outside this range, can be accommodated according to conditions of material, tube sheet thickness and tube wall thickness. The unit is contained in a steel case with dimensions of 14-in. × 9-in. × 6-in., and weighing 19-lb. The torque setting control is provided with a separate and lockable lid to prevent accidental or deliberate alteration by unauthorised persons. The control is suitable for the dual voltage range of 100/120-V a.c., or 210/240-V a.c., 40/60 c/s. A 15-amp. supply is adequate. An indicator knob and dial is incorporated for the easy compensation of voltage variation. The motor is a conventional electric drill type of machine, which is automatically reversed by relays on completion of the expanding operation. There is, however, provision for stopping and reversing the motor at any time in cases of emergency. Standard equipment provided includes a voltmeter and voltage variation adjustment; mains warning light; voltage range selector plugs; spare fuses; lengths of cable and plug; expander motor; one adjustable ball bearing thrust type of expander with spares and three sizes of coupling adapters. (*Charles Wicksteed & Co. Ltd., Kettering.*)

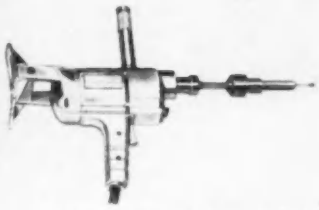


Fig. 5 (above, left). The Mk.IV electric automatic tube-expander control. (Charles Wicksteed & Co. Ltd.)

Axial fan blade design

Collaboration between the General Dynamics' Electric Boat Division, Groton, Connecticut, and Keith Blackman Limited has resulted in agreements being reached to produce in this country patented designs of axial fans with special slotted-blade formation. The slotted-blade provides the means of boundary layer control. This offers the choice of higher efficiency or higher pressure ratios, or a combination of both. Boundary layer control also ensures that with higher pressure ratios and minimum losses due to turbulence and blade friction, the fan size, running speed, airborne noise and structure-borne vibration are all reduced. Many industrial, general marine and aeronautical applications, present themselves for this new fan type which is to be marketed in this country under the trade name "Ax-Slot." (*Keith Blackman Limited, Mill Mead Road, London, N.*17.)

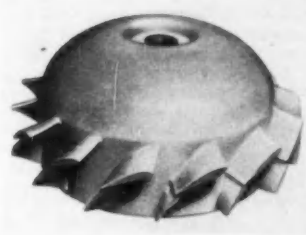


Fig. 6 (above). The new slotted-blade, axial-flow fan impeller. (Keith Blackman Limited.)

Welding equipment for thin materials

New equipment known by the name "Sigmette," and introduced by Quasi-Arc Limited, is designed for the rapid semi-automatic welding of ferrous and non-ferrous materials in gauge thicknesses. The equipment is based on the established Sigma process, and welding is carried out by what is known as the "short-arc" technique, whereby the metal transfer is in globular form, as distinct from the "spray" type of transfer normally associated with Sigma welding. The "Sigmette" welding gun weighs only 3-lb. 1-oz., and a spool carrying either 1-lb. of aluminium wire or 2½-lb. of ferrous wire is carried within the gun itself. Welding can be carried out for periods of up to three-quarters of an hour on one spool of wire. The wire is positioned initially by means of an inching button in the base of the handle. Pulling the trigger starts the gas flow and initiates a slow wire feed. As soon as the arc strikes, the full wire speed comes into operation, and is adjustable by a single knob on the voltage control unit. The gun handles three sizes of wire, being continuously rated at 125-amp., for 0.030-in. wire and at 200-amp. for 3/64-in. and 1/16-in. wires. The standard medium speed wire feed motor fitted gives a wide range of applications with all wire sizes. In addition, high-speed or low-speed motors can be supplied for specialised work using 0.030-in. or 1/16-in. wires. These motors are available either in place of the standard medium speed motor or as optional accessories, motor replacement being carried out quickly and easily. This system enables the complete range of applications to be covered using only one gun. The voltage control unit, weighing 19-lb. 2-oz., controls all welding variables including wire feed

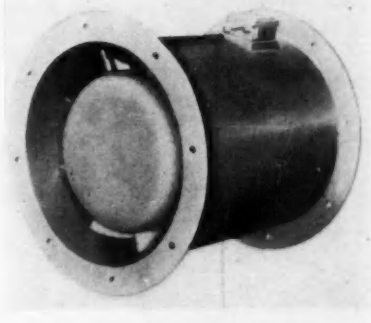


Fig. 7 (above, right). The new "Ax-Slot" fan. (Keith Blackman & Co. Ltd.)

speed and gas flow, and once these are set they are automatically operated by the trigger control on the welding gun. Standard 30-ft. leads between the control and the gun allow a wide radius of operation without having to move the equipment. D.C. power sources, of the motor generator or rectifier type, can be used with the "Sigmette" gun. Equipment recommended by the company is the Quasi-Arc MFB.225 lightweight motor generator set. This small machine has an output current range of 20-225 amp. at 45-60 open circuit volts. When used with "Sigmette" equipment a contactor cubicle is supplied comprising a 200/250 volt single-phase 500-VA transformer with a 115-volt secondary supplying operating current to the gun and control, and a contactor continuously rated at 200 amp. (*Quasi-Arc Limited, Bilston, Staffs.*)

Packaged firing unit for heavy grade fuel oil

Urquhart's (1926) Limited have extended their range of "packaged" oil-firing units by the introduction of the MacFlame series—designed to burn heavy grade residual fuel oil with a viscosity of 960 seconds Redwood. The equipment consists of two compact, easily-installed units—a free-standing console for the

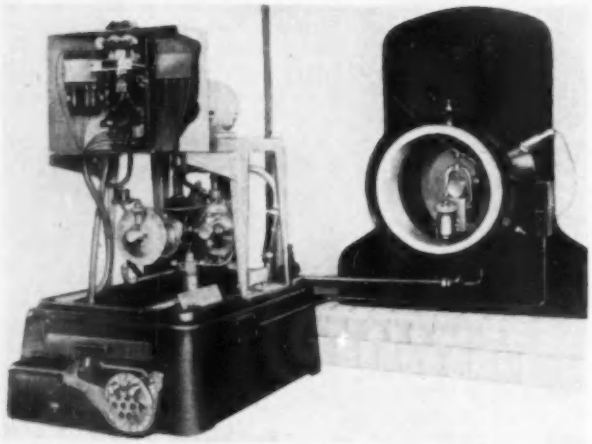


Fig. 8. The Urquhart "MacFlame" oil-firing unit, with covers removed to show the compact arrangement. [Urquhart's (1926) Ltd.

auxiliaries and a boiler front-plate assembly. Each unit further includes a complete interconnecting set of air and fuel pipes, data sheets for specific boilers detailing front-plate and brickwork requirements, and a water thermostat or steam-pressure switch. Five models cover the range of 1,450,000 to 5,500,000 B.Th.U./hr., and in each case the use of a printed circuit in the control unit allows such additional controls as room thermostats or a time switch—not normally built-in—to be interlocked. The console unit, measuring approximately 3-ft. 6-in. by 3-ft. by 20-in., houses an electrically-driven air-compressor, fuel-metering pump, fuel-filter, cut-off valve, h.t. transformer and control unit. A line heater specially designed for 960 seconds fuel, with control and over-temperature thermostats, is built in to the cast-iron base of the console. Ease of access for cleaning and servicing is ensured by this arrangement. The control unit incorporates a sequence timer, a starter for the electric motor, a flame-failure relay designed to "fail safe" under all conditions and sequence indicating lights. The lights, on/off switch, and reset switch are all visible from the outside of the cabinet. The boiler front-plate incorporates a medium-pressure air-atomiser, flame-failure control viewing head, h.t. electric ignition unit and automatic purge and circulating control. Noise level is suppressed in the MacFlame by the front-plate cover which acts as a sound attenuator, and the automatic purge and circulating control both prevents fuel passing the atomiser until the temperature is correct for operating and purges the oil line when the plant shuts down. Each of the five sizes is available in three models:—the MacFlame "Automatic" with on/off control system; the "Auto/Hilo" which operates on high/low/off system; and the "Auto-Ratio" which is fully-modulating. [*Urquhart's (1926) Limited, 5, Wadsworth Road, Perivale, Greenford, Middlesex.*]

Steam valve for general distribution

Hattersley (Ormskirk) Limited announce that the "Preseator" globe valve, suitable for steam at 200-lb./sq. in. and 500 deg. F., has been added to their current range. The special design of this valve is claimed to overcome the destructive wire drawing effect of steam, and in addition materials are employed which eliminate seat galling and corrosion. The valve incorporates a unique flexible titanium alloy disc, resistant to corrosion and erosion which closes before the main seating surfaces. The broad-faced clack and seat are of differing nickel alloy composition giving a differential surface hardness which prevents galling and seizure.

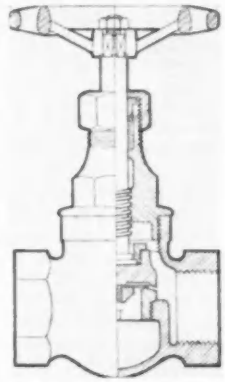


Fig. 9. Outline arrangement of the Hattersley (Fig. 2016) "Preseator" steam valve. [Hattersley (Ormskirk) Limited.

The sequence of operation of the valve is such that the main seating surfaces are protected from pipe scale and the effects of wire drawing as the flexible disc permits them to seat under virtually "no flow" conditions. The "Preseator" has been tested by the company, who say that it has, over a period of years on many different installations under service conditions, proved to be ideal for operation in the partly open position. The valve is available with either threaded or flanged ends. [*Hattersley (Ormskirk) Limited, Ormskirk, Lancashire.*]

X-ray inspection at Hinkley Point

A 250-kV mobile industrial X-ray unit (type TF 1555B), supplied by Marconi Instruments Limited to Babcock & Wilcox Limited, is now in use at Hinkley Point Nuclear Power Station. As we have previously mentioned in this journal, the sub-assemblies for the shells of the steam-raising units are fabricated by fusion-welding at the Dalmuir works of Babcock & Wilcox Limited and shipped to site via the Combwich Wharf, some five miles from the Hinkley site. When welding on site is completed, the weld surface is prepared for examination and the joint X-rayed. The steel plates for the reactor spherical pressure-vessel are formed at the Babcock works at Renfrew, each course of plates being pre-assembled on jigs to check shape and alignment. Groups of several

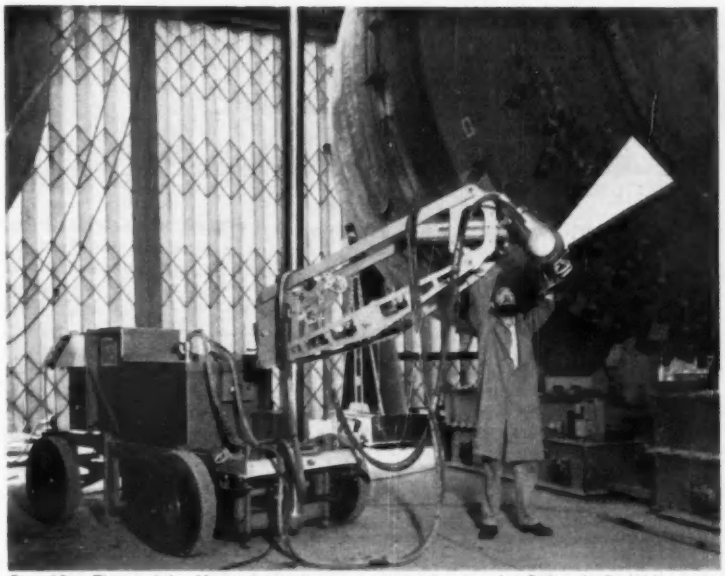


Fig. 10. The mobile X-ray inspection unit operating in the Babcock & Wilcox site fabrication shop at Hinkley Point.

plates are fully-welded at the works, into assemblies suitable for transport to site. The plate assemblies as received from the works are built into complete circumferential courses in the site pre-fabrication shop, the joints between them are then manually welded, following which a thorough X-ray inspection is carried out. The Marconi X-ray apparatus is of the constant potential type, and the basic equipment comprises four main items—high-tension transformer-rectifier unit, control unit, oil-cooled tubehead, and an oil circulator/cooler unit. A mobile trailer, which is towed into position on site, accommodates the complete apparatus, including the control unit. The equipment is fitted with an extended lift and a taller than normal tube column, providing a wide range of movements essential for X-ray inspection of large units of this kind. The accompanying illustration shows an X-ray unit in the Babcock and Wilcox fabrication shop at the Hinkley site. (*Marconi Instruments Limited, St. Albans, Herts.*)

Lancashire Dynamo Electronic Products Limited, Rugeley, Staffs., announce that they have introduced a Planned Maintenance Scheme for customers in the United Kingdom. The scheme, which will be operated by the Service & Field Operations Department, involves four visits per annum and will be undertaken on a two-year contract basis with annual payments. The annual charge will depend upon the size and value of the equipment, and a uniform scale has been adopted for the whole country. This includes a fixed charge for the visit to site, plus a percentage of the original invoice price of the equipments to be maintained. These charges will include all travelling, travelling time and time working on site, but any replacement material or components used during the visits will be charged at normal spares list prices. It is felt that the scheme will be of particular value to the small factory or plant where maintenance facilities and the availability of skilled personnel are likely to be limited. Larger organisations should also derive considerable benefit from the scheme, in that a regular check will be made of the performance of the equipment, thus ensuring that the original standard of operation is maintained.

* * *

A new catalogue for Dixylon Plastic Transmission belting, the precision bolting for high speed drives, which is stretchless, silent and smooth running, has been published by **R. & J. Dick Limited,** Greenhead Works, Glasgow, S.E. The catalogue, which describes in detail Dixylon plastic transmission belts that will operate at velocities of 10,000-ft./min., gives much useful information on belt thicknesses, co-efficients of friction, horse-power rating per width of belt, etc.

Nineteen standard, or full courses, have to date been held at the **Harwell Reactor School,** and Standard Course No. 20 will start on January 4th, and continue until April 29th, 1960. Altogether, 1,004 students from 32 different countries have so far attended these courses, which began in September, 1954, and are designed to train engineers in the techniques of reactor construction and operation, particularly in connection with nuclear power stations. Half the places at each course are allocated to overseas students, and a fee of £250 exclusive of accommodation is charged. A special course for Senior Technical Executives will be held from May 9th to 20th, 1960. This is the tenth course of this kind, and the fee is fifty guineas exclusive of accommodation. Application forms, and details of both courses, can be obtained from:—The Principal, Reactor School, A.E.R.A., Harwell, Didcot, Berks.

* * *

The research facilities of Bristol Siddeley Engines Limited have recently been increased by the installation of a low-temperature test chamber for minus 65 deg. F., to enable low-temperature tests to be carried out on aero and diesel engines and motor car engines. The chamber was installed at the company's Anstey Research Establishment by **The Midland Heating & Ventilation Co. Ltd.,** together with its associate company, Carter Thermal Engineering Limited.

* * *

From **The Incandescent Heat Co. Ltd.,** Cornwall Road, Smethwick, Birmingham, we have received a new illustrated leaflet (F.P.2) describing Incandescent-Whiting wet dust arresters for foundry applications. A further publication (F.P.1), also recently made available, describes Incandescent cupolas.

The Power-Gas Corporation Limited, well known as an engineering company supplying design, manufacturing and erecting services to the chemical, petroleum, petrochemical, gas, nuclear energy, iron and steel and general engineering industries, has transferred its trading activities to two wholly-owned subsidiaries which operate from the same addresses in Stockton-on-Tees and London. **Ashmore, Benson, Pease & Co. Ltd.** continue to control the Stockton works, which manufacture and sell all types of heavy engineering products, and will specialise in the design, manufacture and supply of plant and equipment for the iron and steel industry. **P.G. Engineering Limited** is a newly formed subsidiary within the Power-Gas Group, and undertakes the design, supply and erection of plant and equipment for the chemical, petroleum, petrochemical, gas, nuclear energy, and other industries. The products and services of this company will follow upon similar lines to those previously available through its parent company—The Power-Gas Corporation Limited. This re-organisation results from the expansion of the company's activities, and will benefit their clients throughout the world by a greater concentration of attention upon their individual needs. None of the other members of the group is affected by this re-organisation.

* * *

"Industrial Electric Heating" is the title of the latest film available on free loan from the **Electrical Development Association,** 2, Savoy Hill, London, W.C.2. Available in both 16-mm. and 35-mm. the film has a running time of 30-min., and deals briefly with the theory, and at length with the practice, of electrical process heating of all kinds, and as applied to most industries.

OVERSEAS Steam Engineering Practice

Abridgments of recent articles in the colonial and foreign technical press, concerning design and progress in the technique of steam generation and power plant equipment

Use of flow models for boiler-furnace design

Much of the work in boiler and furnace design concerns the determination of the shape and size of ducts, pipes and enclosures that will produce efficient flow of air, gases, and fluid fuels to and through the system. It is now well recognised that the flow-distribution patterns of furnace gases affect the efficiency of combustion, the heat transfer to furnace surface, the amount and location of furnace and superheater fouling, and the rate of deterioration of furnace and superheater surface due to corrosion, erosion, wastage, and so forth. Except for simple configurations, the prediction of these flow patterns is impractical or impossible by ordinary analytical methods and, even though it might be possible to write differential equations for certain flow conditions, it is not always possible to solve them. The use of scale flow models is an excellent method for solving flow problems. The use of water models was adopted in the design of the super-critical-pressure steam generator at the Philo Plant of the Ohio Power Company. Two-dimensional open-channel water models at 1/24 scale were used extensively to explore various furnace arrangements. For these tests the height and depth of the furnace were built to scale, but the width represented by the height of the walls on the model was only 1½ to 3 in. instead of the 17 in. that would have been needed if built to scale. Water in sufficient quantity was used to assure turbulent flow in the model. The flow pattern was made visible by sprinkling ground black pepper on the surface of the water, and permanent records were obtained by taking photographs. The first proposed furnace arrangement is shown in outline in Fig. 1. The water-model tests indicated that mixing would be satisfactory, but that the gas-mass-flow upset entering the convection pass would be excessive. Other arrangements were then tested. Some of these accomplished good mixing, but had high mass-flow upset, while others did the opposite. In some arrangements the furnace pressure-drop was excessive. The arrangement shown in Fig. 2 appeared to solve all these problems satisfactorily. (*R. W. Curtis and L. E. Johnson, Transactions of the ASME, Journal of Engineering for Power*, Vol. 81, October, 1959, pp. 371-379.)

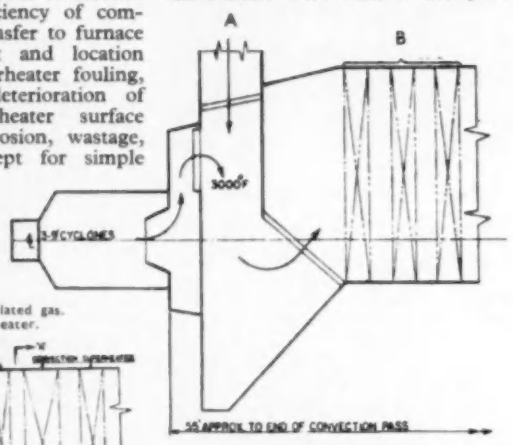


Fig. 1 (right). Longitudinal section of proposed furnace arrangement for Philo super-critical steam generator.

KEY: A. 800 deg. F recirculated gas.
B. Convection superheater.

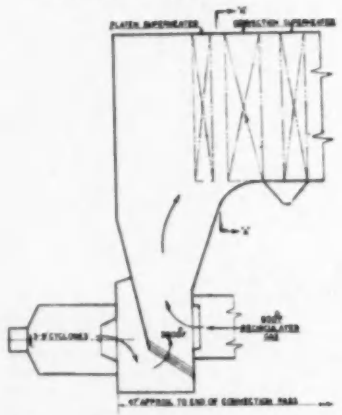


Fig. 2. Longitudinal section of the final furnace arrangement.

Storage of pulverised fuel

Because of the need for readily available reserves of power, coal is stored in the bunkers of a predetermined number of standby boilers at the Trenton Channel station of the Detroit Edison Consumers Power Companies, of America. Fires were experienced when coal was left in the bunkers, and in an effort to eliminate this problem, a number of tests were undertaken. The plant on which the tests were made included a low-pressure section comprising six 50-MW turbo-alternators, which receive steam at 400 lb./sq. in. and 720 deg. F. through a common header from thirteen 300,000 lb./hr. boilers, and from a high-pressure plant through a 600,000 lb./hr. reduction station. A central coal pulverising plant, comprising 20 Babcock & Wilcox pulverising mills, provides relatively dry (1 to 2 per cent. moisture) coal for the bunkers on both the high- and low-pressure boilers. The coal burned in both

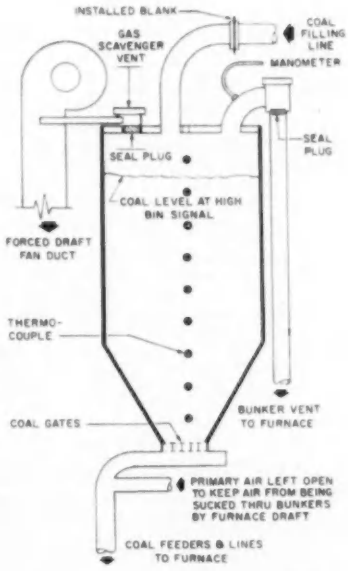


Fig. 3. Outline arrangement of coal bunker showing vents and seals.

plants is "run of the mine" bituminous coal containing between 1 and 1½ per cent. sulphur. A representative proximate analysis would be 6.1 per cent. moisture, 32.9 per cent. volatile matter, 53.0 per cent. fixed carbon, and 8.0 per cent. ash. Each low-pressure boiler has two 75-ton bunkers, one feeding the east coal burners and the other feeding the west coal burners. All bunkers are equipped with a scavenger vent system and all vent to the furnace (see Fig. 3). Based on information from the tests, coal is currently being stored using the following method: the bunker is filled to high bin signal to expel as much air as possible; the coal feeder gates are left open so that coal in the feeders will help to seal the bottom of the bunker; the primary air dampers are left open to prevent furnace draughts from sucking air through the coal feeders; all coal transport and vent lines are blanked off; a dial thermometer is installed in the air space 6 in. below the top of the bunker to show any temperature rises indicating fire; a pressure indicator or sample connection is provided to watch for possible generation of gas. At the present time coal is being kept in ten boiler bunkers without difficulty. To gain additional information about gas generation, daily samples are taken with an M.S.A. gas analyser (calibrated on methane) which reads in per cent. explosive. With this method of storing coal in boiler bunkers, it is anticipated that the Trenton Channel Plant will soon be in a position to add as much as 200-MW of generation to the system in approximately four hours. (*Combustion*, Vol. 31, No. 4, pp. 45/47.)

Stoker-fired "packaged" boiler

The Foster Wheeler Corporation of America are now prepared to offer stoker-fired "packaged" boilers in three standard sizes:—43,000, 50,000 and 63,000 lb./hr. of saturated steam at operating pressures up to 250 lb./sq. in. This decision follows the successful operation of a prototype unit developed by the company for the Bureau of Yards and Docks of the U.S. Navy. The prototype was designed for an m.c.r. of 30,000 lb./hr. at 250 lb./sq. in., and is of the two-drum, natural-circulation type. The furnace, boiler and economiser measure approximately 12-ft. high by 9-ft. wide by 25-ft. long. Interchangeable oil- and coal-firing boiler fronts are provided. The furnace sidewalls consist of ninety-two 2-in. o.d. tubes on 2½-in. centres. The roof is formed by a continuation of alternate sidewall tubes going into the opposite upper sidewall headers. The furnace rear wall consists of 2-in. o.d. tubes on 3-in. centres, expanded into the upper drum. As these tubes form the slag screen, they are staggered on 6-in. transverse and 4½-in. longitudinal centres. The front furnace wall is composed of 9 in. of refractory and 2½-in. of mineral wool block. The furnace volume is 1,035-cu. ft. The bridgewall, composed of refractory and castable, is internally water-cooled and located at the rear of the stoker. The boiler bank contains 1,840 sq. ft. of heating surface. It is composed of 2-in. o.d. tubes on 3-in. transverse centres. The integral extended surface economiser consists of 4⅝-in cast-iron gilled rings shrunk on 2-in. o.d. tubes. It is four rows wide, twelve rows high, 6½-ft. long and contains 938 sq. ft. of heating surface. The stoker, manufactured by the Hoffman Combustion Engineering Company, consists of two feeders and a two-section forward ash discharge grate of 70.5 sq. ft. effective area. Each grate section may be operated independently. An auxiliary 5 h.p. blower provides both overfire air and re-injection air. Six venturi re-injection nozzles are furnished for the hoppers which are located beneath the slag screen and the economiser. The oil-firing equipment, manufactured by the Peabody Engineering Corporation, includes two 13½-in. steam atomising burners, complete with fittings. The duplex pumping and heating set, also supplied by Peabody, is a factory-assembled "packaged" unit, complete with pipes, valves and fittings. The set can deliver 300 gal./hr. of fuel oil to the burners at 220 deg. F. and 125 lb./sq. in. The dust collector-induced draught fan-stack section was manufactured by the American Blower Corporation. The mechanical dust collector is of the high-draught loss type. The forced-draught fan was also furnished by American Blower. Combustion controls and instruments for the stoker-fired packaged steam generator were designed and manufactured by General Regulator Corporation, a Foster Wheeler subsidiary. These are of the metering-type, and were factory-assembled, except for drives, in a free-standing instrument panel. The water-cooled bridgewall was modified on site after initial operation, to prevent the short-circuiting of burning fuel particles at the rear of the stoker into the soot-hoppers located beneath the slag-screen. This problem was overcome by increasing the bridgewall height by 2-ft. and providing a slag-ledge, thereby effectively lengthening the flame-path. In future units, an overfire air-duct, placed in the bridgewall, will accomplish the same effect. (*Heat Engineering*, Vol. 34, No. 4, pp. 56/61.)

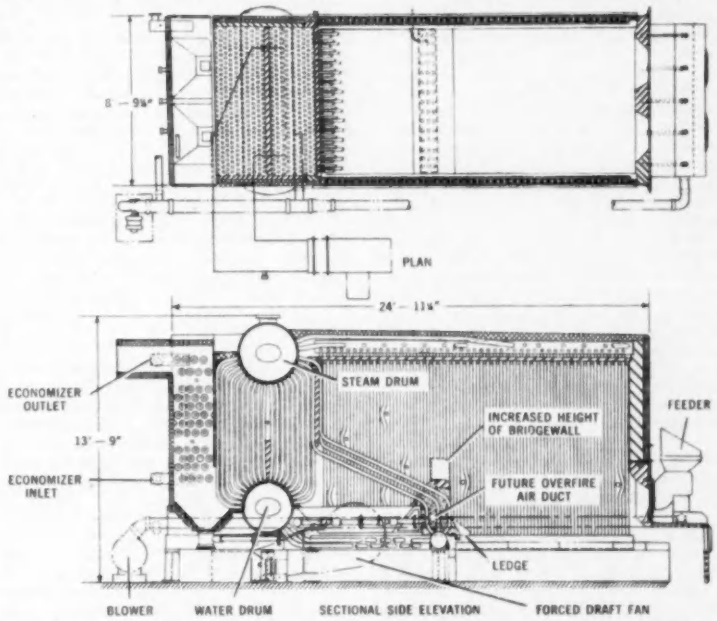


Fig. 4. Plan and side elevation arrangements of the prototype stoker-fired "packaged" boiler developed by the Foster Wheeler Corporation. Modifications in bridgewall height and the provision of a slag-ledge are indicated by dotted lines.

Most powerful hammer-mill in Central Europe

It is reported that one of the three hammer mills to be installed for pulverising the fuel required for firing the boilers associated with the first 100-MW section of the new power station to be constructed at Tisová, near Carlsbad, Czechoslovakia, will be the most powerful hammer-mill hitherto constructed in Central Europe. When completed, the power station itself will be the largest in Czechoslovakia. The mill, which is to be constructed of special armoured plate, will be approximately 3 metres (9.85-ft.) high. The mill rotor, which will carry several rows of wear-resisting swing-hammers, fabricated from special magnesium steel alloy, will be 2½ metres (8.2-ft.) long, 160-cm. (5.25-ft.) diameter, and weigh 5½-tons. It will be made from a single steel forging, and in operation will rotate at a speed of 1,000 r.p.m. The fuel will be pulverised to a fine powder by the action of the hammers striking the coal. The design of the rotor includes a complete cooling system, which will prevent it becoming overheated due to the rapid movement of the equipment. The total weight of the new mill will be approximately 27-tons. (*Czechoslovak Heavy Industry No.* 12, 1959, p. 35.)

At a ceremony at the offices of the Midlands Project Group of the C.E.G.B at Meadow Lane, Nottingham, on November 10th, a presentation was made to **Mr. F. Favell,** Wh.Ex., M.I.Mech.E., M.I.E.E., to mark his retirement after 40 years' service in the electricity supply industry. The presentation, which consisted of an electric mixing machine and an automatic tea maker, was made by **Mr. R. R. Maddock,** chief project engineer, Midlands Project Group. After serving with the Battersea, and Stoke-on-Trent, Electricity Departments, Mr. Favell joined the newly-constituted North-West Midlands Joint Electricity Authority in 1930 as a generation engineer, and three years later was appointed chief engineer and manager. With the reorganisation of the supply industry in 1948, Mr. Favell was appointed chief generation engineer (construction) in the East Midlands Division of the then British Electricity Authority, which position he held until the formation of the Projects Groups in 1958, when he became associated with the Midlands Project Group, until his retirement on August 31st, last.

* * *

Mr. J. D. Buchan has been appointed assistant manager, Publicity Department, of Metropolitan-Vickers Electrical Co. Ltd. Mr. Buchan joined Metropolitan-Vickers in 1928, working first in the company's Swansea office. He transferred to the head office on the Lamp & Lighting Department, London, in 1936, and in 1938 joined the Publicity Department, Trafford Park, to handle Lamp & Lighting Department publicity. Resuming this work after five years' service in the R.A.F., he was later concerned additionally with publicity for Heating & Welding Department; Newton Victor (the company's X-ray Department); and Scientific Apparatus Department.

* * *

Mr. John D. Bolckow, assistant general manager, has been appointed a director of Redpath Brown and Co. Ltd.

* * *

Air Control Installations Limited announce that **Mr. D. G. Hill** has been appointed manager of their air filter department.

* * *

"Bestobell Cocks" is the title of the latest brochure in a series describing the "Bestobell" range of valves and fittings available from **Bell's Asbestos and Engineering Limited,** Bestobell Works, Slough, Bucks. Some six types are described, available in bronze, cast-iron or gun metal, for steam pressures up to 250-lb./sq. in.

In order to clarify the association with their parent company, **The Morgan Crucible Co. Ltd.,** Battersea, the name of **Synthetic Carbon & Engineering Co. Ltd.** has been changed to **Morgan Components Limited.** Production capacity at the Stanmore Works has been enlarged, and will be concentrated on the sales and production of all brush holders hitherto manufactured by The Morgan Crucible Co. Ltd. and Synthetic Carbon & Engineering Co. Ltd. Morgan Components Limited will continue to manufacture and supply a variety of metal contacts and associated metal assemblies, which were formerly supplied by the Synthetic Carbon & Engineering Co. Ltd. Enquiries and orders for carbon brushes and carbon contacts, formerly supplied by the Synthetic Carbon & Engineering Co. Ltd., should now be sent to The Morgan Crucible Co. Ltd., Battersea Church Road, London, S.W.11.

* * *

Wallace & Tiernan Limited, Power Road, London, W.4, announce the formation of a Precision Instruments and Aids to Navigation Department in their organisation. This department will be responsible for the manufacture and marketing of pressure sensitive instruments and navigation aids. Highly accurate instruments in this category have been produced for many years by W. & T.'s Associate Company in the U.S.A., and this new development will meet the increasing demand for similar equipment of British manufacture. The Wallace & Tiernan pressure sensitive instruments are available for various applications and include:—pressure indicators, gauges, vacuum and differential pressure indicators, and pressure control instruments. All instruments are precision manufactured and individually calibrated. **Mr. J. T. Furness,** who has been with the company for 10 years, has been appointed manager of the new department. **Mr. G. L. Walton,** previously manager in North-East England, will take over responsibilities from Mr. Furness as manager in the East Lancashire area.

* * *

Teddington Industrial Equipment Limited announce the appointment of **Mr. S. N. Griffin** as their sales and service engineer in Scotland. Mr. Griffin can be contacted at 7, Elm Terrace, Loanhead, Edinburgh (tel.: No. Loanhead 398), in connection with all matters appertaining to automatic controls for heating, ventilating and air-conditioning, engine protection and pneumatic gauging.

The second report of the Joint Standing Committee on Safety, Health and Welfare Conditions in Non-Ferrous Foundries, published by the **Ministry of Labour** on November 17th, is devoted to known and potential health hazards in non-ferrous founding. The committee is of the opinion that the report on known risks prepared by its technical sub-committee, to whom the question of health risks was remitted, "warrants the close attention of the industry," which it is urged should act on it as soon as possible. Attention is drawn to a medical appendix covering both known and potential risks, and the committee comment that a "good knowledge of this part would result in the avoidance of many risks which might be introduced inadvertently with new processes." The committee agrees with its sub-committee in their view that medical supervision is desirable wherever it can be arranged, and that a general medical survey of the industry would help greatly by establishing the type and magnitude of the health risks involved. Copies of the Report are obtainable from H.M. Stationery Office, price 1s. 9d. net.

* * *

Mr. George Henry Cook, Lincoln district engineer to the East Midlands Electricity Board, died recently in Lincoln County Hospital at the age of sixty-three. He went to Lincoln from Bolton in 1928 as assistant electrical engineer to the Corporation. In 1939 he became deputy electrical engineer and manager, a post he held until he became district engineer when the electricity supply industry was nationalised.

* * *

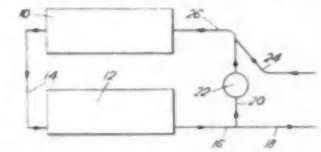
The Mond Nickel Co. Ltd. have produced a further publication in the series dealing with the development of S.G. Iron. The new publication, which is fully illustrated, describes in detail the properties of S.G. Iron, and lists a number of important applications. The section on properties, which will be of particular interest to designers and metallurgists who are already familiar with S.G. Iron, includes numerous tables and information on strength, toughness and ductility, elasticity, fatigue resistance, hardness, wear-resistance, thermal properties and corrosion-resistance. Among the applications featured are examples of the use of this material in power, transport, mining and chemical plant, and civil engineering. The publication may be obtained free on request from the company's Publicity Department, Thames House, Millbank, London, S.W.1.

Latest Power Plant Patents

These extracts from British Patent Specifications are reproduced by permission of The Controller of H.M. Stationery Office. (Complete British Specifications can be obtained from the Patent Office, 26, Southampton Buildings, London, W.C.2. Price 3s. 6d. each, both inland and abroad.)

Multi-stage flash evaporator

This invention relates to evaporators equipped with flash chambers. In the diagram shown in Fig. 1, the block (10) represents a number of series-connected heaters. The liquid to be evaporated passes through each of these heaters in turn, and is then passed along a pipe line (14) into the flash-chambers (12). The heated liquid is passed from flash-chamber to flash-chamber through orifices joining the lower parts of the flash-chambers, and the vapour passes upwards and out of the flash-chambers into the heaters through orifices or pipes which are not shown in Fig. 1. The liquid which is not evaporated, is withdrawn from the final flash chamber through the pipe line (16). Part of the withdrawn liquid is generally removed from the circulatory system through the pipe-line (18) while the remaining part is fed through the pipe-line (20) to



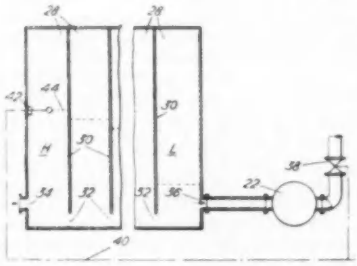
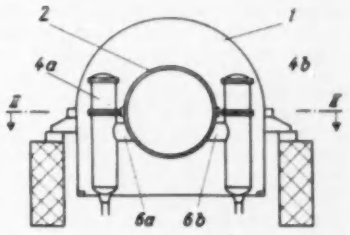


Fig. 1 (top). Fig. 2 (bottom). British Patent No. 823,239.

the suction side of a liquid circulating-pump (22). To compensate for the liquid which is evaporated in the flash chambers and the liquid which is discharged through the pipe (18) fresh make-up liquid is supplied to the circulatory system through the pipe-line (24). This pipe-line is shown as joining the pipe-line (26) on the delivery side of the pump (22). Under some circumstances it may be more convenient to arrange the blow-down line (18) on the delivery side of the pump (22) and/or the feed-line (24) on the suction side of the pump. Although details of construction of the evaporator are not shown in Fig. 1, it is to be assumed that the evaporator is so designed that, in operation, the pressure and corresponding saturation temperature within the flash-chambers decreases from flash chamber to flash-chamber. Fig. 2 shows in some detail the actual construction of the flash-chambers. The flash-chambers (28) take the form of rectangular compartments formed by the partition walls (30) and connected in series by orifices (32) formed in the lower parts of the partition walls. Heated liquid from the heaters (10) enters the flash-chamber *H* which operates at highest pressure through the orifice (34) and leaves the flash-chamber *L*, operating at lowest pressure through the pipe (36). The orifices (32 and 34) are especially dimensioned so as to suit full-load operation. This means that on no-load or low-load operation, the difference in the liquid levels from flash-chamber to flash-chamber is increased by an amount corresponding to the vapour pressure head which is available on full-load operation, but which is non-existent on no-load operation. Without special precautions, the liquid level in the high-pressure flash-chamber *H* and the chambers immediately next to it could rise to such an extent that liquid would be carried over from the flash-chambers into the heaters (10) and contaminate the distillate condensing in them. In accordance with the invention, such a rise in the levels of the liquid in the flash-chambers (28) is prevented by a throttle valve (38) which controls the effective output of the pump (22) circulating the liquid through the evaporator. The valve is controlled through an electrical, mechanical, hydraulic, pneumatic or other kind of link (40) by a liquid level-sensitive device (42) arranged in the flash chamber *H*, or one of the flash-chambers immediately adjacent to it. Thus, when the liquid level (44) in the chamber *H* reaches such a height as to actuate the level sensitive device (42), the valve (38) is automatically moved towards its closed position so as to reduce the effective output of the pump (22) which will bring down the liquid levels in the flash chambers to a safe value. *British Patent No. 823,239 issued to Richardsons, Westgarth & Co. Ltd. Complete specification published November 11th, 1959.*

Turbine with bled-steam feed-water preheater

Feedwater preheaters which are heated with bled-steam from a turbine have hitherto generally been separate from the turbine, that is, located by themselves, and connected to the bleed points of the turbine, by more or less long pipes. It has, however, already been proposed to build a low-pressure pre-heater into the exhaust steam of the turbine.



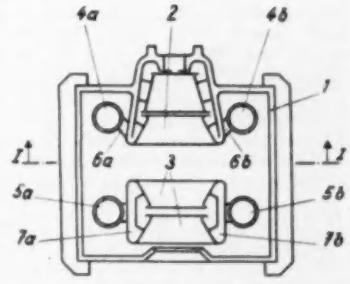


Fig. 3 (top). Fig. 4 (bottom). British Patent No. 823,267.

The present invention consists in a steam turbine set with a low-pressure casing and with bled-steam feed-water preheating characterised by the feature that at least one feed-water preheater is arranged vertically,

wholly in the interior of the low-pressure casing and alongside an inner casing of the turbine set. Figs. 3 and 4 show a constructional example of the invention in the form of a low-pressure casing of a large multi-cylinder turbine; Fig. 3 is a vertical section through the casing along the line *I-I* of Fig. 4, and Fig. 4 a horizontal sectional view taken along axial plane *II-II*. Low-pressure casing (1) contains the inner casings (2 and 3) of the triple-flow low-pressure cylinder of the turbine as well as low-pressure feedwater preheaters (4a, 4b) and (5a, 5b) connected to the last two bled-steam extraction stages of the turbine. Preheaters (4a, 4b) are connected to the penultimate pressure-stage, and preheaters (5a, 5b) to the lowest pressure-stage. The bled-steam pipes for the first pair of parallel-connected preheaters are shown at (6a, 6b) whilst those for preheaters (5a, 5b) are at (7a, 7b). The feedwater supply connections to the preheaters (4a, 4b, 5a, 5b) have been omitted from the drawing for the sake of simplicity. On the water-side, the preheaters are arranged in pairs and in parallel. A large amount of space is saved by building the preheaters into the low-pressure casing of the turbine, when compared with the usual preheater plants. The difficulties encountered when large low-pressure bled pipes have to be arranged so as to pass through the low-pressure turbine casing are thus avoided. The bled connections are short, and the amount of material required is small. There is no need to provide tight connections, because these, as well as the preheaters, are completely in vacuum. In order to reduce the volume of a single preheater it is an advantage to divide the preheater for a certain pressure-stage into two symmetrical part preheaters with corresponding bled pipes. The space required inside the turbine casing is thus diminished. Furthermore, if tube defects occur in one of the part preheaters, this preheater can be shut-off from the feedwater supply, whereby the turbine does not need to be stopped, and in such a case, the whole feedwater will flow through the other part preheater. When compared with those known preheaters which are built horizontally into the exhaust steam outlet of a turbine, the present arrangement possesses the advantage that all difficulties which otherwise are encountered when the foundation has to be raised are avoided. *British Patent No.* 823,267 *issued to Aktiengesellschaft Brown, Boverie & Cie. Complete specification published November* 11*th*, 1959.

Pulverised-fuel-fired furnace

This invention relates to furnaces for the combustion of pulverised-fuel. The pulverised-fuel is usually fed suspended in air through burners into the combustion space within the furnace. The carrier air serves at the same time as primary combustion

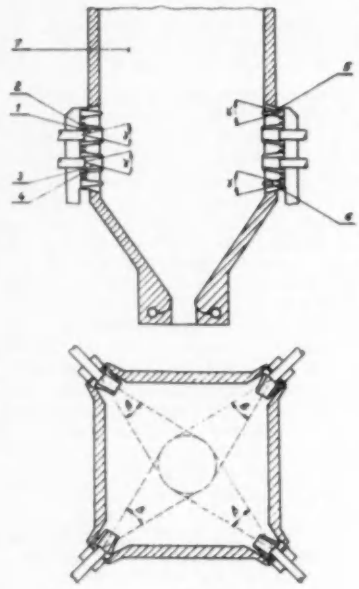


Fig. 5. (top). Fig. 6 (bottom). British Patent No. 823,401.

air. Usually, further combustion-air, so-called secondary air, is introduced into the furnace through the fuel burners. Still further air, the so-called tertiary-air, which is required for complete combustion, is supplied through separate air nozzles. According to the invention, a furnace for the combustion of pulverised-fuel is equipped with burners which supply the fine fuel suspended in primary-air, and have nozzles for tertiary-air. The arrangement is made such that the fuel burners, as well as the tertiary-air nozzles, are privotally mounted so that they can be deflected independently of one another in a vertical as well as in a horizontal direction. As a result of this arrangement, it is made possible to adjust the resulting flame requirements of a particular fuel. It is possible to lengthen, or to shorten, the paths of the burning fuel particles, and it is also possible to improve the mixing between the fuel and the tertiary combustion air. Particularly favourable results are obtained if the burners and the air nozzles are arranged in the corners of a combustion chamber of square cross-section. The fuel streams are usually directed in such combustion chambers as tangents to an imaginary circle in the centre of the combustion chamber. By adjusting the tertiary-air nozzles in a vertical plane, the tertiary combustion-air can be directed to the points where it is required to promote the combustion, and by adjusting the tertiary-air nozzles in a horizontal direction, an air swirl even in a direction opposite to the rotating fuel can be obtained which intensifies the mixing between the fuel and air and substantially contributes to the achievement of complete combustion. Fig. 5 shows a longitudinal section of the pulverised-fuel-fired furnace, and Fig. 6 shows the furnace in cross section. Inside the furnace (7) at its corners, are arranged in two horizontal planes the fuel burners (1 and 3) with the nozzles (2 and 4) respectively for the secondary-air. The tertiary-air is admitted through additional nozzles (5 and 6). The burners (1 and 3) with their air nozzles (3 and 4) as well as the tertiary-air nozzles (5 and 6) are adjustable mutually independently both in vertical and horizontal directions. The position of the burners (1 and 3) with their nozzles (2 and 4) and the position of the nozzles (5 and 6) can be adjusted in accordance with the properties of the fuel to be burnt in a vertical plane within the range of the angle α, and in a horizontal plane within the range of the angle β. By suitably adjusting the burners and the nozzles for the supply of tertiary-air in the vertical and in the horizontal direction, it is possible to establish the most favourable combustion conditions; in particular to improve the mixing of the fuel with air, so that the reaction speed increases and a complete burning of the volatile constituents is facilitated. Thus, losses arising from incomplete combustion are substantially reduced and the furnace can be operated with less excess-air. A higher efficiency of the furnace and therefore a lower fuel consumption are the result. *British Patent No.* 823,401 *issued to Prvni Brnenenska Strojirna, Zavody Klementa Gottwalda. Complete specification published November* 11*th*, 1959.

Control system for nuclear power plant

This invention relates to control systems for nuclear power plants. The type of plant to which the invention particularly, but not exclusively, relates is that in which heat developed in the reactor is removed by means of a cooling fluid, flowing in a closed circuit. This cooling fluid subsequently gives

up its heat outside the reactor to raise steam in a boiler, the steam being used to drive a steam turbine or turbines. With such plants it is necessary to vary the output of the reactor in response to variations in output of the turbo-generator plant. It is desirable that such control of output should be effected as quickly as possible. The invention consists in a control system in which a device, responsive to variations in the power required from the reactor, is used to vary automatically the amount of cooling fluid circulated through the reactor. It consists further, in a device responsive to variations in a temperature which is a function of the temperature of the nuclear fuel, this device being used to vary the multiplication constant of the reactor. The nuclear power plant shown diagrammatically in Fig. 7 comprises a nuclear reactor (1), a heat-exchanger (2), a turbine or turbines (3), condenser (4), an electric generator (5) and a blower (6) for circulating a cooling fluid through the reactor in a closed-circuit (7). Associated with the outlet from heat-exchanger (2) for working fluid on its way to turbine (3) is a control device (8) which is set so that variation of the pressure of the working fluid causes the device to operate a speed-control (9) on the blower or blowers (6). Variation of the outlet temperature of the cooling fluid leaving the reactor causes a device (10) to operate on a device (11) which adjusts the position of the control rods (12) within the reactor. This control rod movement varies the multiplication constant for the reactor, that is to say the ratio of neutrons present at a given time to the number present on finite lifetime earlier, and hence the power output. The operation of the system is as follows: should the power demand on the turbo-generator fall, the pressure of the working fluid at the heat-exchanger outlet rises. This variation in pressure operates the device (8) causing a controlled reduction in speed of the blower (6) until such time as the original pressure conditions are restored. The immediate effect of this reduction in speed of the blower or blowers is to increase the temperature difference between reactor outlet and inlet. As a result of the negative temperature coefficient of the reactor, the multiplication constant decreases, resulting in a thermal power decrease. As the power decreases, the effect is that the above-mentioned temperature difference decreases and consequently the rate of change of power is reduced. If the outlet temperature of the cooling fluid varies, the device (10) is brought into operation and the control rods are moved into or out of the reactor to change the power output in such a manner as to correct the variation in temperature. The control system continues to operate until the following two conditions are satisfied. (*a*) The initial pressure conditions of the working fluid at the heat-exchanger outlet are restored, that is to say the blower speed-change approximately matches the power change. (*b*) The initial temperature conditions at the reactor outlet are restored. *British Patent No.* 823,429 *issued to Parolle Electrical Plant Co. Ltd. Complete specification published November 11th*, 1959.

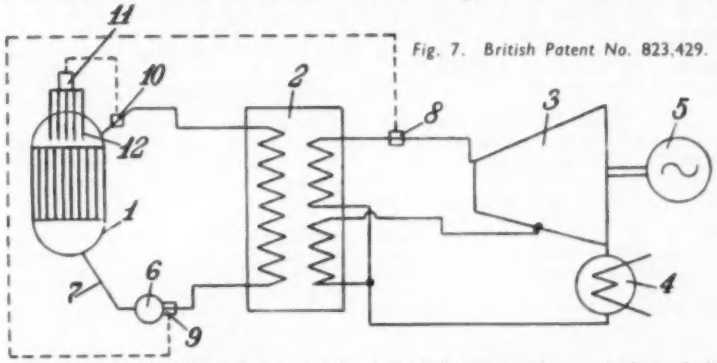


Fig. 7. British Patent No. 823,429.

A new leaflet (Publication No. 1704) available from **Babcock & Wilcox Limited,** Babcock House, 209, Euston Road, London, N.W.1, describes Babcock electrically-operated unidirectional-drive soot blowers. The unidirectional-drive type of retractable sootblower incorporates a new design of mechanism that does not require reversal of the operating motor, and thus is claimed to simplify automatic sequence-control of soot-blowing in large boilers. The entire operation of traversing the nozzle into the furnace, rocking it over the blowing angle the required number of times and retracting, is carried out by mechanical means without the use of clutches, and with a non-reversing motor.

* * *

In order to provide improved and enlarged office accommodation in Birmingham and the surrounding area, **Keith Blackman Limited** have moved from their office in New Street, Birmingham, 2, to 1651, Pershore Road, Birmingham, 30. Tel. Kings Norton 4151/2.

* * *

Mr. Herbert Slack has been appointed to the board of Kelvin & Hughes (Industrial) Limited, as sales director. Mr. Slack formerly held the position of technical sales manager.

To mark the appointment of the **Accurate Instrument Company,** Dublin, as the Irish agents of **John Thompson Instrument Company,** Wolverhampton, a cocktail party and film show was given by John Thompson Group directors, at the Shelbourne Hotel, Dublin, during the evening of Tuesday, November 3rd. The guests were John Thompson's clients and potential clients in Eire and Northern Ireland. Some of the directors, together with senior members of the staff of the John Thompson Group, were present, while the guests included representatives of the Eire Board of Works, Electricity Supply Board, Dublin Docks Board, Dublin Corporation, Bord-na-Mona (Turf Board), and Industrial Organisations in Eire.

* * *

Mr. J. C. C. Whyte, formerly technical representative for the West Midlands and Mid-Wales areas of W. H. Allen Sons & Co. Ltd., Bedford, has been appointed manager of the company's new Central Counties branch office at Lloyd's Bank Chambers, 85, Regent Street, Leamington Spa, opened recently. A staff of engineers will operate from the new office, covering the Midlands, Cheshire, Lancashire, Yorkshire, the Western Counties and Wales.

The Consolidated Pneumatic Tool Co. Ltd., 232, Dawes Road, London, S.W.6, announce the opening of a new district office in Bristol to serve industry in the West of England. The new office, is under the management of **Mr. J. D. Glover** and is located at 1, Bedminster Down Road, Bristol, 3. (Telephone No. Bristol 63736.) Its operations will cover the counties of Somerset, Devon, Cornwall and part of Gloucester. The company's branch office at Bridgend, Glamorganshire which previously served this area will continue to operate as the South Western District for the South Wales counties, Hereford and part of Gloucester.

* * *

Associated Electrical Industries Limited is to supply the C.E.G.B. with 275-kV air-blast switchgear to control the output of the nuclear power station to be built at Trawsfynydd, North Wales. The value of the contract is £900,000; 275-kV, 7,500-MVA Type GA10W8 air-blast circuit breakers and associated equipment, manufactured at the Trafford Park unit of the A.E.I. Switchgear Division, will be installed in an outdoor, double-busbar switching station. The station will incorporate circuit breakers and isolators of 2,000-amp rating.

NOTES *Personal* AND *Industrial*

Mr. E. C. Fox, general manager in India for The English Electric Co. Ltd., has been appointed managing director of The English Electric Company of Australia (Pty.) Ltd., from the beginning of January next, in succession to **Mr. C. W. Goodman,** who has passed normal retiring age. Mr. Goodman will continue full-time service as chairman of the Australian company. In India, **Mr. N. P. Dingwall,** former manager of the company's Calcutta office, has replaced Mr. Fox as general manager.

* * *

Mr. B. Williams has been appointed resident technical sales representative at the Bristol office of Crofts Limited, power transmission engineers, Bradford, Yorks., in place of **Mr. Dawson,** who has retired. Mr. Williams will represent the company in Hampshire, Dorset, Wiltshire, Somerset, Cornwall, and Devon.

* * *

Mr. A. Kirkham has resigned from the board of Sir W. H. Bailey & Co. Ltd., Patricroft, Manchester, and joined the Foundries Division of David Brown (Industries) Limited, Penistone.

* * *

Mr. C. H. Flurscheim, M.I.E.E., a director and chief electrical engineer, of Metropolitan-Vickers Electrical Co. Ltd., has been co-opted to serve on the council of the British Welding Research Association.

* * *

Mr. Kenneth Roney has been appointed Technical Press Officer in the Public Relations Department of the National Coal Board at Hobart House, London, S.W.1. This is a new post created as part of the present sales drive to promote the increased use of solid fuel. Mr. Roney was formerly publicity manager of C.W.B. Furnaces Limited, Dudley, Worcestershire.

* * *

Mr. A. Eccleston, until recently Western area representative for Smiths Industrial Instrument Division, has now been appointed as the company's North-East area representative. In this newly-created post, he will serve Northumberland, Durham, and the North, East and West Ridings of Yorkshire. His new office address is: Permanent House, The Headrow, Leeds, 1. Replacing Mr. Eccleston in the Western area is **Mr. Edmond H. Smith,** who joins Smiths Industrial Instrument Division from Kelvin and Hughes Industrial Limited, where he was also electro-medical representative.

* * *

Mr. V. J. Speller, formerly education and training officer of the North West, Merseyside and North Wales Region, has been appointed chief assistant public relations officer of the Central Electricity Generating Board in succession to **Mr. Peter J. Field,** who was recently appointed public relations officer.

The Distington Engineering Co. Ltd. branch of The United Steel Companies Limited has announced that **Mr. A. E. Bell** has been appointed commercial manager and has assumed responsibility for the buying department of the branch.

* * *

Ferranti Limited announces the following appointments:—**Mr. W. D. H. Gregson** has been appointed assistant general manager of the company's Edinburgh factory and will take up his duties towards the end of this year. **Mr. J. P. Newberry** is to succeed Mr. Gregson as London area manager, and **Mr. P. McGregor** becomes senior transformer sales engineer, London area, both appointments becoming effective from November 1st. **Mr. J. C. Heywood** has been appointed sales manager of the electronics department and has been succeeded in the instrument department by **Mr. H. L. Harrison** as departmental sales manager.

* * *

Mr. J. D. Riddle, B.Sc.(Eng.), D.I.C., A.M.I.Mech.E., A.M.I.E.E., has been appointed manager of the British Thomson-Houston Turbine Factory, Rugby. He joined BTH in 1949 as a design engineer in the rectifier engineering department, and two years later transferred to turbine methods development. In 1956, Mr. Riddle became assistant superintendent of the turbine factory and was appointed superintendent in 1958. He succeeds **Mr. J. S. Borrington** who has been appointed to the staff of the director of manufacture, responsible for the organisation of manufacturing-staff training.

* * *

Mr. H. B. Dreyfus, B.Sc.(Tech.), M.I.E.E., formerly a principal assistant engineer in the Engineering Department of the Central Electricity Generating Board at headquarters, has been appointed system design and development engineer of the Board.

* * *

Sir Philip Southwell, C.B.E., M.C., who recently retired as managing-director of the Kuwait Oil Company, has now been appointed chairman of the British subsidiary of Brown & Root, Inc., engineers and constructors of Houston, Texas, U.S.A., who have recently opened their London offices at 6, Arlington Street, St. James's, S.W.1.

* * *

The General Electric Co. Ltd. has announced the following appointments: **Mr. T. B. O. Kerr,** director of finance and administration; **Mr. W. O. Humphreys,** director for research and technical development; **Mr. W. J. Bird,** director for sales and marketing development.

* * *

Admiral Sir Michael M. Denny, G.C.B., C.B.E., D.S.O., has been appointed a director of English Steel Corporation Limited.

Sir John Pickles, M.I.E.E., has been re-appointed chairman of the South of Scotland Electricity Board for the period from January 1st, 1960, to December 31st, 1963. **Sir David Anderson,** M.I.Mech.E., has been appointed to be a part-time member of the Board for the period from January 1st, 1960, to December 31st, 1962, in place of Sir John Imrie, whose present appointment ends on December 31st, 1959.

* * *

It is with regret that we announce the death on October 30th, at the age of forty-nine, of **Mr. Alfred George Wilson,** production manager of Laurence, Scott & Electromotors Limited. Mr. Wilson completed his apprenticeship at the company's Norwich works in 1926, and subsequently became service manager (in 1942) and production manager (in 1945). Mr. Wilson was not related to Mr. G. H. Wilson, the managing director of the company.

* * *

John Laing and Son Ltd. has announced the formation of **Lytag Limited,** a new company which will produce lightweight aggregate from pulverised-fuel ash at a factory adjoining Northfleet (Kent) Power Station. The headquarters of the company are located at Manor Way, Boreham Wood, Hertfordshire.

* * *

The General Electric Co. Ltd. announces that **Mr. C. F. Boyes** has been appointed manager of the central London area branch, and **Mr. F. H. Farthing** has been appointed manager of the south eastern area branch.

* * *

British Boiler Accessories Limited have entered into an arrangement with the **Toronto Iron Works Limited,** Toronto, Canada, for the sale of B.B.A. steam accumulators and helical coil heat-exchangers in Canada. The association between the two companies has started with a big contract for the supply of steam accumulators to the new Carling Breweries' installation in the City of Toronto.

* * *

W. H. Allen Sons & Co. Ltd. Bedford, have received through the consultant (Mr. J. S. Clinton) an order on behalf of the Municipality of George, South Africa, for a 3,000-kW turbo-alternator with feed-heating plant, condensing plant, and ancillary equipment.

* * *

Laurence, Scott & Electromotors Limited would like to hear from ex-apprentices with whom they have lost touch. It is hoped to arrange for a get-together, possibly during the run of the Electrical Engineers Exhibition next year. Ex-apprentices are asked to give details of their present whereabouts, either to Mr. W. F. Symes at Gothin Works, Norwich, or by telephone to Mr. T. J. Barfield at Temple Bar 5223.

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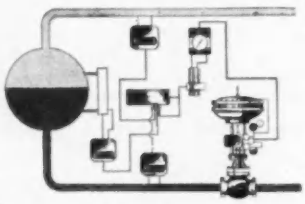
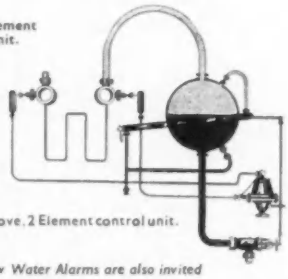


Left, 3 Element control unit.



Above, 2 Element control unit.

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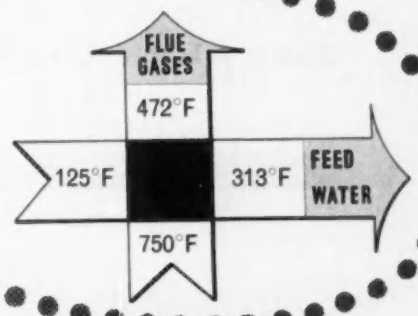

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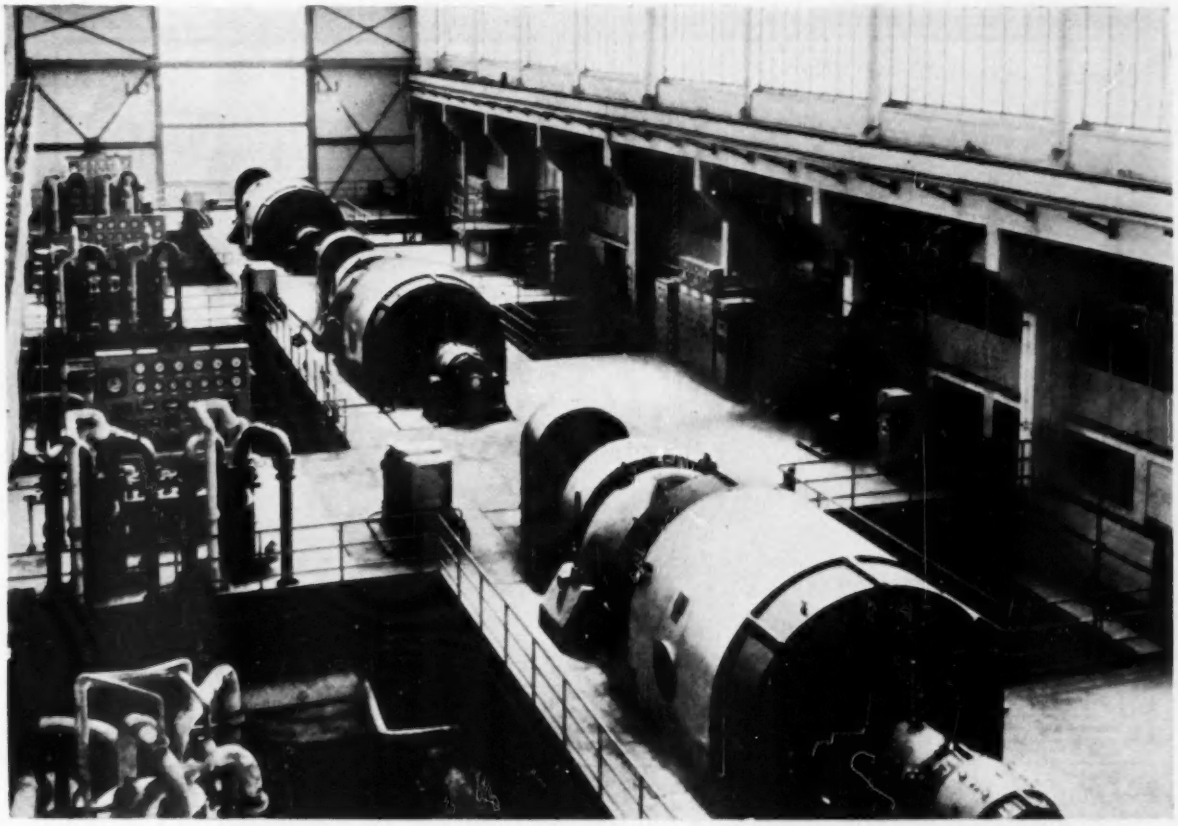

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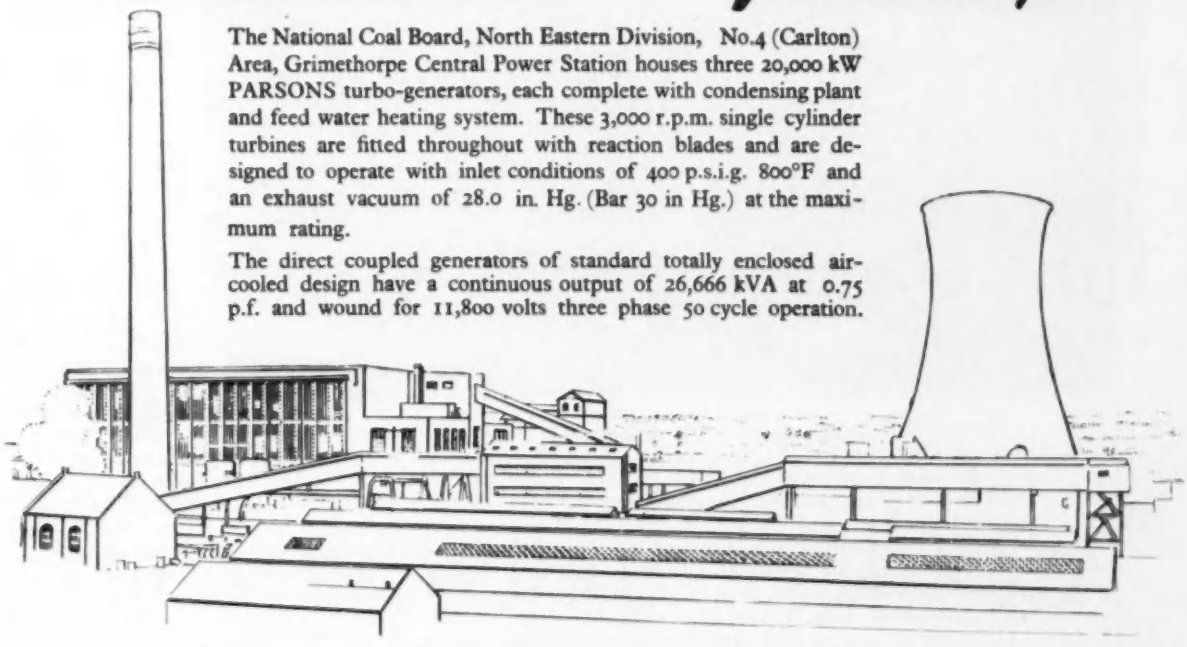

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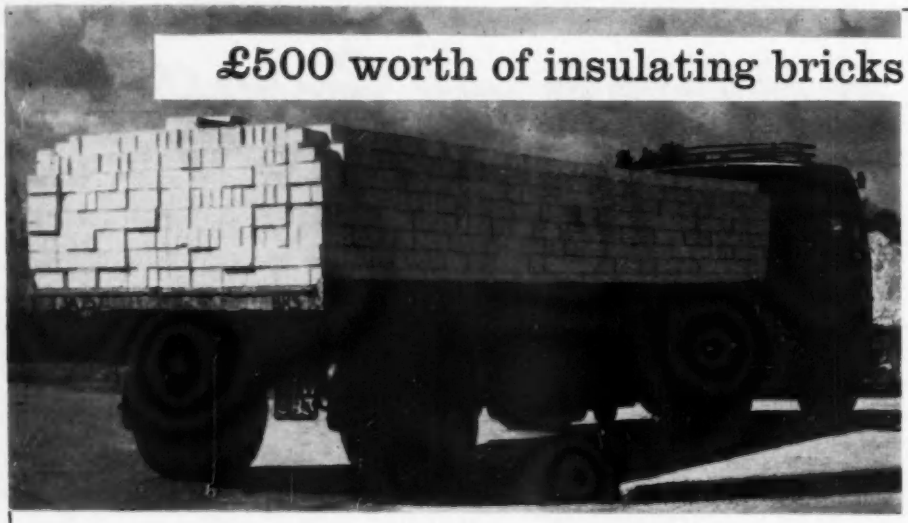

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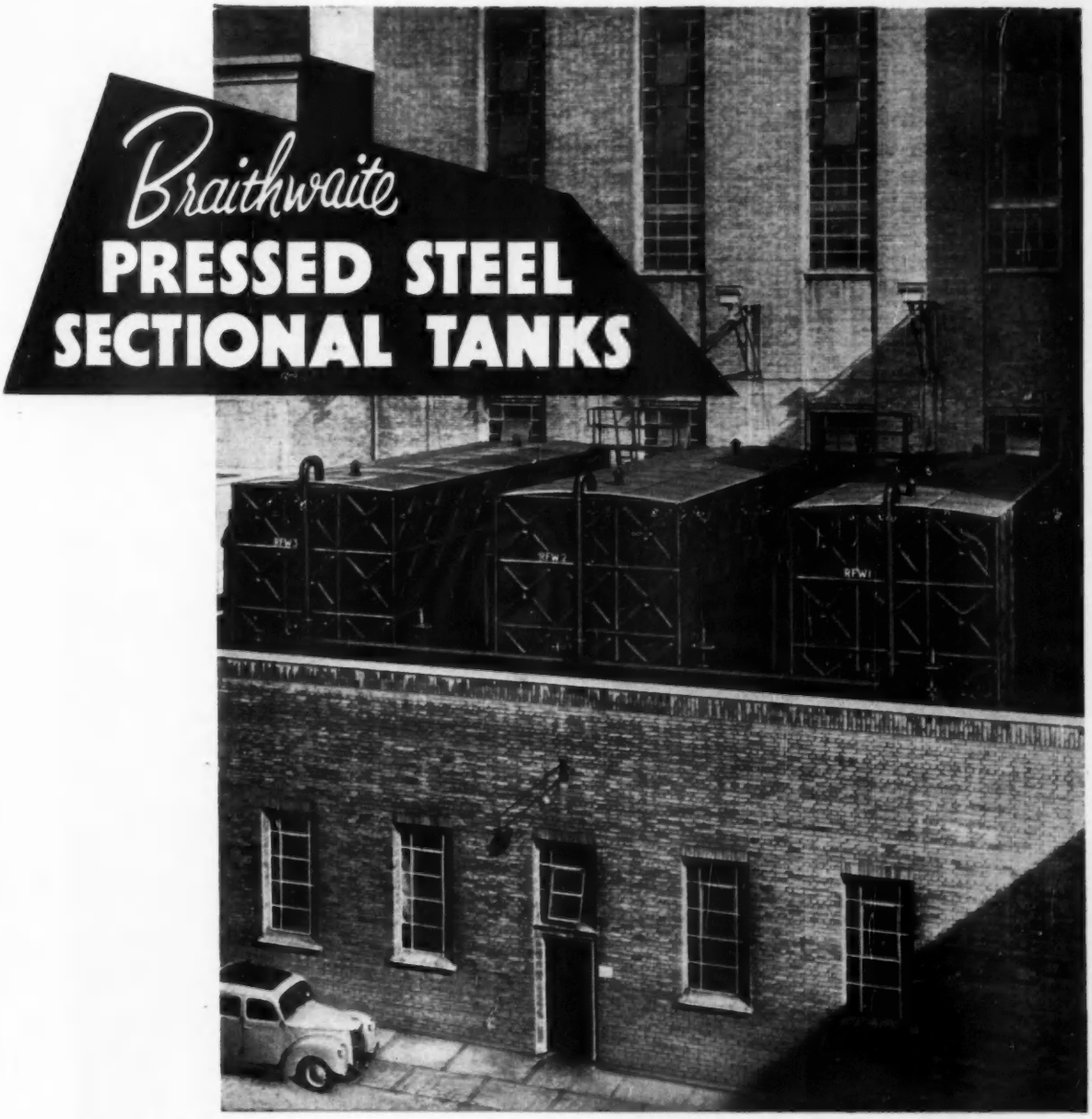

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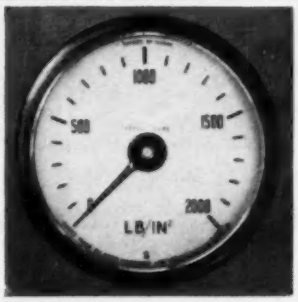

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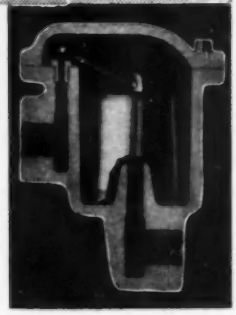

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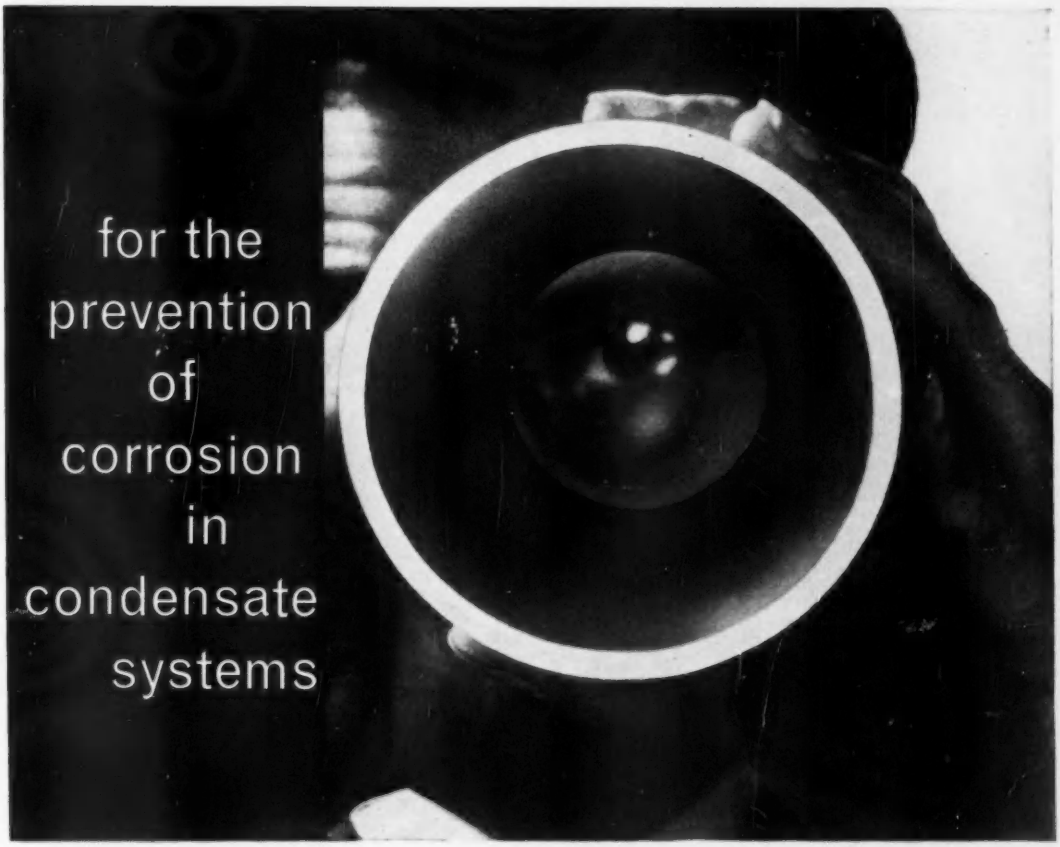

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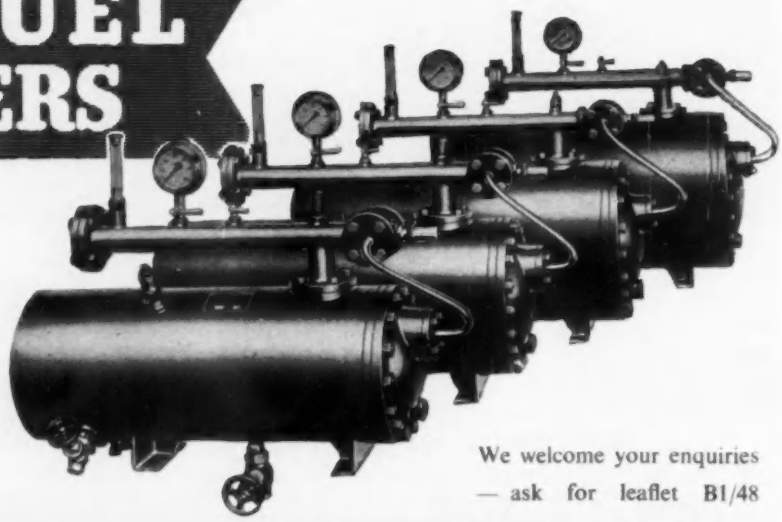

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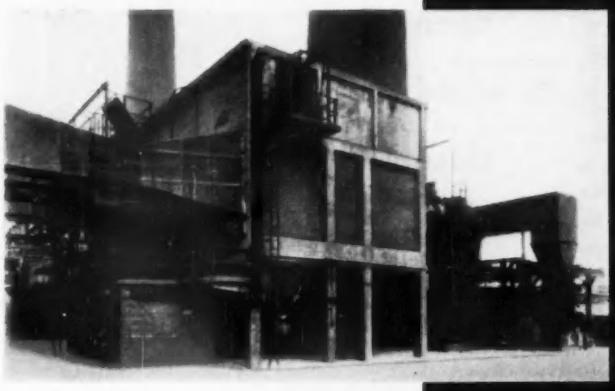

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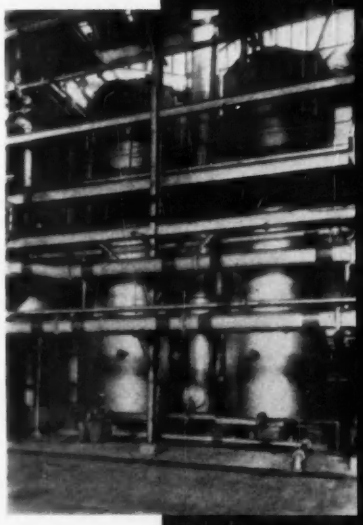

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Holmes-Elex Electrical Precipitators removing acid mist fumes resulting from the manufacture of sulphuric acid at the Trafford Park Works, Manchester, of Messrs. Courtaulds Limited.

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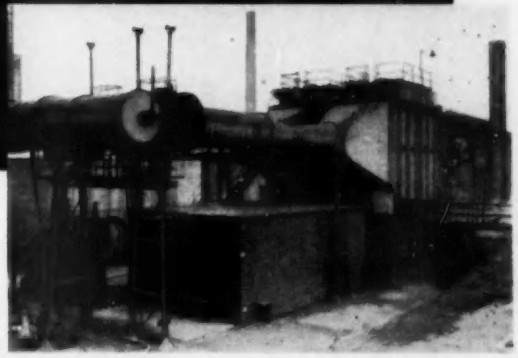

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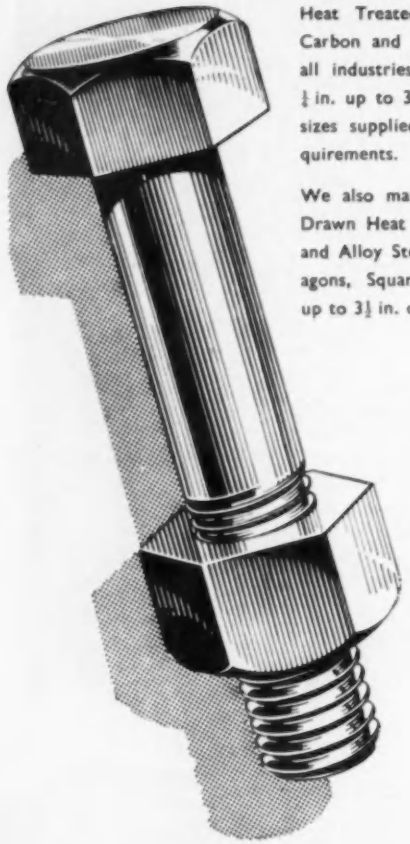

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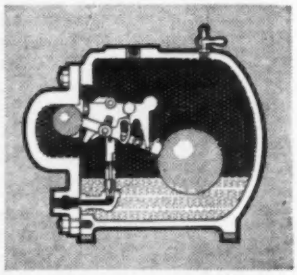

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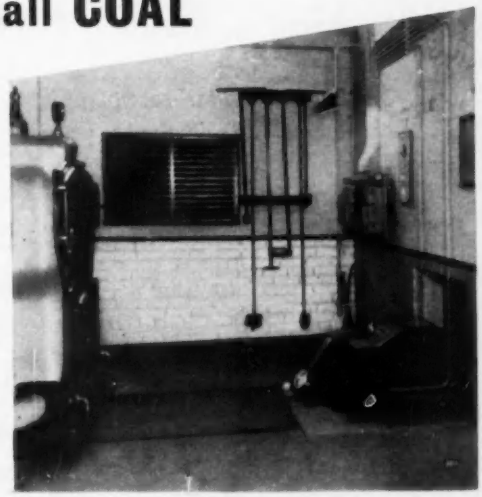

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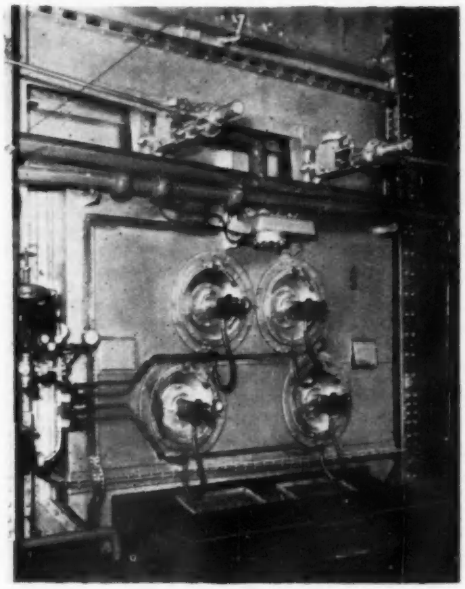

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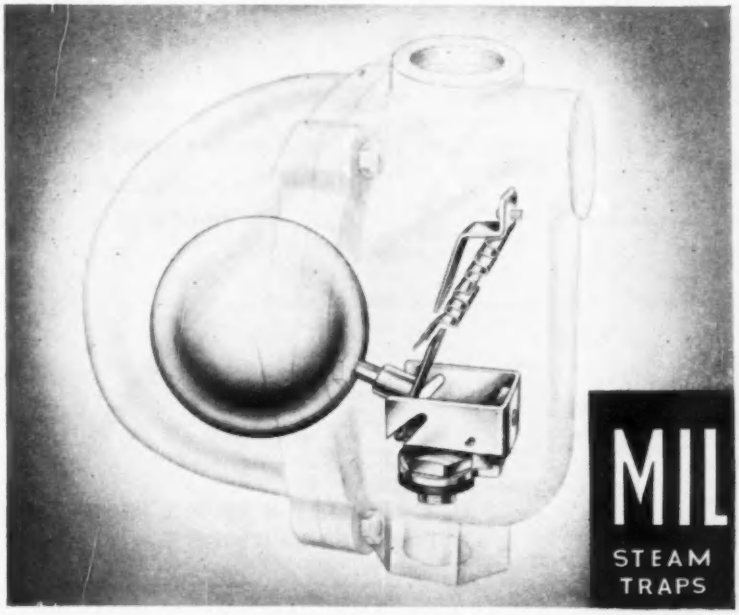

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Index to Advertisers

	Page
Albright & Wilson Ltd.	lxiii
Allen, W. G., & Sons (Tipton) Ltd.	x
Associated Electrical Industries Ltd.	xxviii, lii
Babcock & Wilcox Ltd.	liv
British Ermeto Corporation Ltd.	xxiv
British Industrial Eng. Co. (Staffs.) Ltd.	xxxix
British Paints Ltd.	lxxii
Broady, Wm., & Son Ltd.	lxxii
Caird & Rayner Ltd.	lxiv
Cape Asbestos Co. Ltd.	xxxv
Carborundum Ltd.	iv
Clarke, Chapman & Co. Ltd.	xliv
Classified Advertisements	lxx
Clyde Blowers Ltd.	lvi
Cochran & Co. (Annan) Ltd.	v
Copes Regulators Ltd.	lvi
Cory, Wm., & Son Ltd.	xl
Crane Ltd.	i
Danfoss Manufacturing Company	Back Cover
Danks, Edwin, & Co. (Oldbury) Ltd.	xii
Darlington Insulation Co. Ltd.	lv
Defur Descaling Services Ltd.	lxiv
Dohm Ltd.	xxxviii
Electroflo Meters Co. Ltd.	Cover i
Engineering Appliances Ltd.	xxi
Fibreglass Ltd.	viii
Fraser & Fraser Ltd.	xxxiv
G.W.B. Furnaces Ltd.	xlviii
Green, E., & Son Ltd.	xlix
Gregory, J. G., & Son Ltd.	lxx
Harcourt, D., Ltd	lxii
Hargreaves Ltd.	xxxvi
Hick Hargreaves & Co. Ltd.	vii
Hodgkinson, J., (Salford) Ltd.	xxvii
Holmes, W. C., & Co. Ltd.	lxv
Hopkinsons Ltd.	xlv
Howden, James, & Co. Ltd.	xix
International Combustion Ltd.	xxiii
Judd Budd Ltd.	xxxiv
Kay & Co. (Engineers) Ltd.	xiv
Kennedy, Allen, & Co. Ltd.	xiii
Lafarge Aluminous Cement Co. Ltd	lxxi
Laidlaw, Drew & Co. Ltd.	lviii
La Mont Steam Generator Ltd.	xxvi
Lancaster & Tonge Ltd.	lxii
Leeds Meter Co. Ltd.	lxvii
Lockheed Precision Products Ltd.	ii
Midland Industries Ltd.	lxix
Mitchell Engineering Ltd.	xlvi, xlvii
Moler Products Ltd.	lx
National Coal Board	xxxii, xxxiii
Newalls Insulation Co. Ltd.	xviii
Nu-Way Heating Plants Ltd.	xxxi
Parsons, C. A., & Co. Ltd.	lix
Permutit Co. Ltd.	iii
Prior Stokers Ltd.	lxvii
Proctor, J., Ltd.	xlix
Reavell & Co. Ltd.	lx
Ruston & Hornsby Ltd.	li
Senior Economisers Ltd.	lvii
Simon-Carves Ltd.	xxxvii
Simplifix Couplings Ltd.	xlii
Smith Bros. & Co. (Hyson) Ltd.	lxvi
Sound Control Ltd.	xliii
Spencer-Bonecourt-Clarkson Ltd.	lx
Spirax-Sarco Ltd.	xxv
Sturtevant Engineering Co. Ltd.	xli
Sulzer Bros. (London) Ltd.	xx
Superheater Co. Ltd.	lxxiii
Thompson, J., Ltd.	xi
Thornycroft, John I., Co. Ltd.	lxix
Tress Eng. Co. Ltd.	lxii
United States Metallic Packing Co. Ltd.	lxvi
Vokes Genspring Ltd.	xxx
Wallsend Slipway & Eng. Co. Ltd.	xv
Walworth Ltd.	vi
Ward, Thos. W., Ltd.	lxi
Weir, G. & J., Ltd.	xxii
Wickstead, C., & Co. Ltd.	lviii
Willcox, W. H., & Co. Ltd.	xvii
Winn, W. Martin, Ltd.	lxvi
Yarrow & Co. Ltd.	xvi

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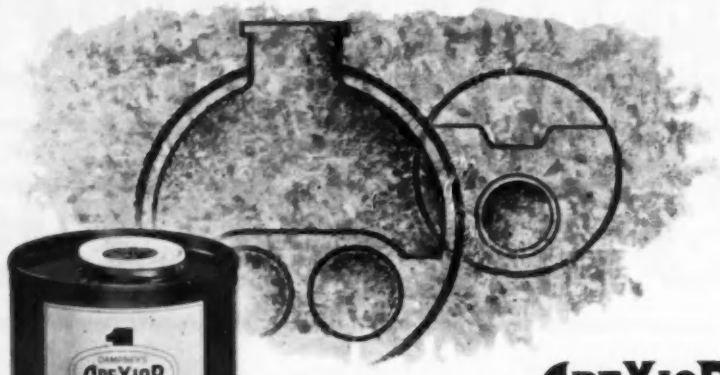

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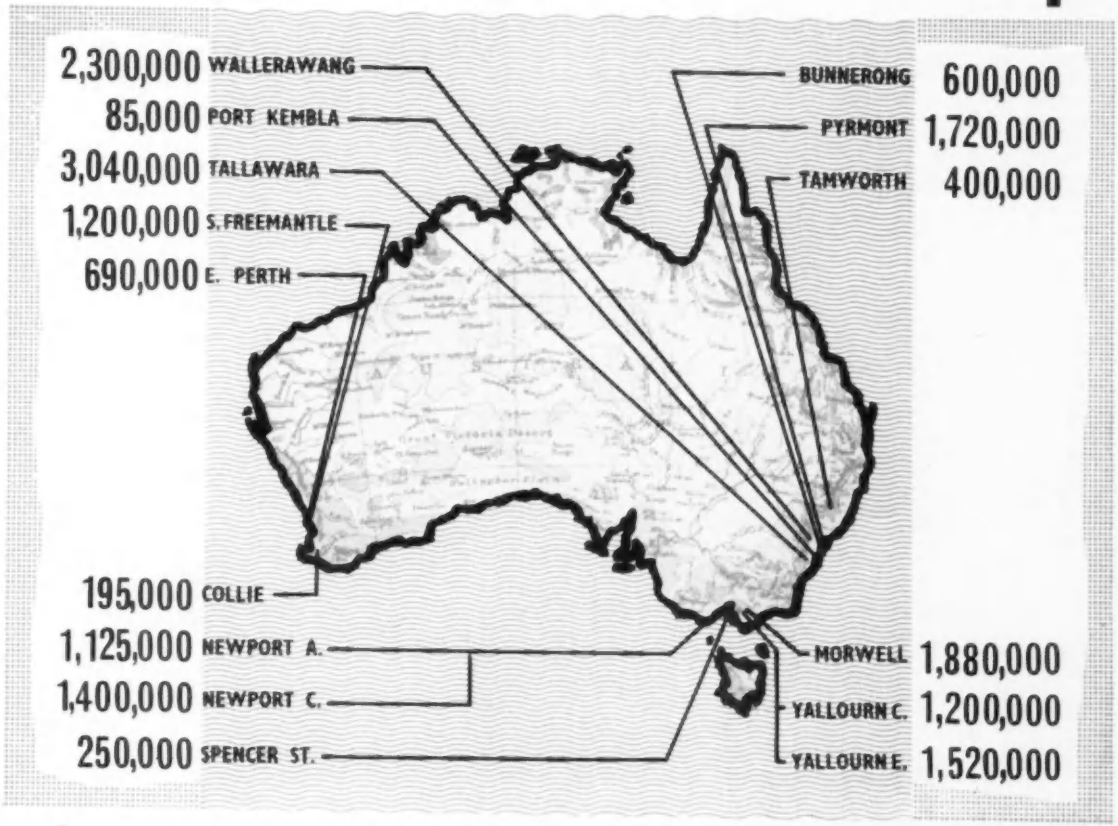

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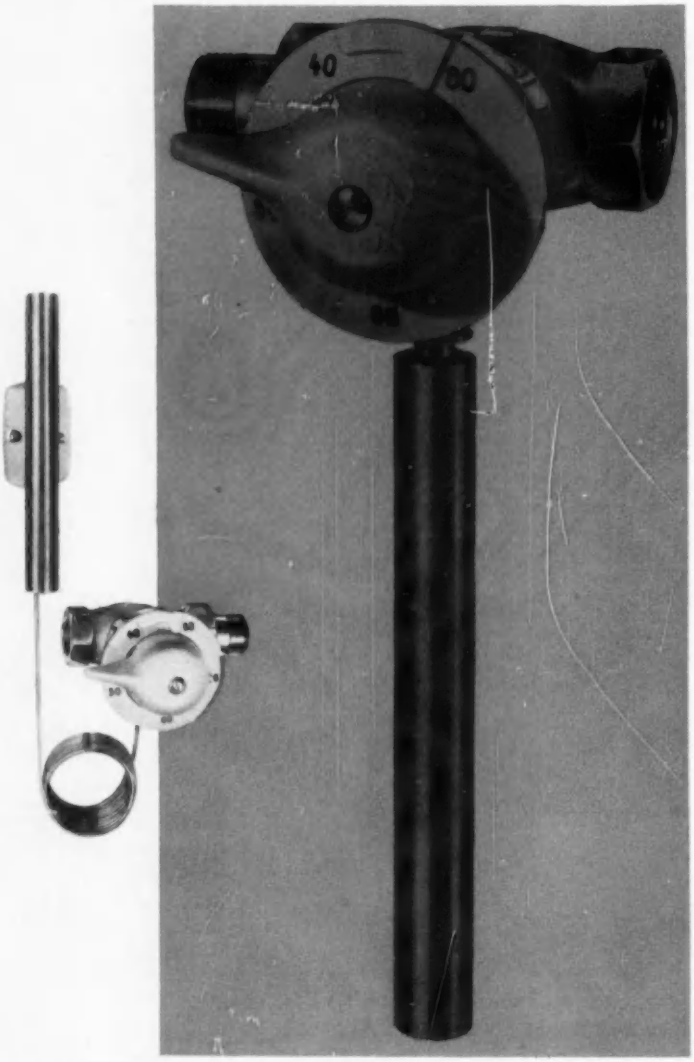

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